100762 ORIGINAL (Red)

Witco

Witco Corporation
One American Lane
Greenwich, CT 06831-2559
(203) 552-2000
(203) 552-2010 Fax

28 June 1996
2061604

Mr. Eric Newman
Remedial Project Manager
U.S. Environmental Protection Agency
DE/MD Remedial Section (3HW42)
841 Chestnut Building
Philadelphia, PA 19107

Re: Response Action Report
Halby Chemical Site
Wilmington, Delaware
Administrative Order for Removal Response Action
Docket No. III-95-55-DC

Dear Mr. Newman:

Pursuant to Section 8.11 of the Administrative Order for Removal Response Action, Witco is submitting three copies of the Response Action Report which has been completed as proposed in the revised Response Action Plan. The Response Action Report documents the response actions implemented by Witco at the Halby site.

If you should have any questions or require additional information, please give me a call.

Very truly yours,

Witco Corporation

Rajnikant Vyas

Rajnikant Vyas
Project Coordinator

RV:gr
G:\DATA6\20616\PHASE04\RAR.LTR

cc: Jane Biggs-Sanger - DNREC
Robert Root - CH_2M Hill
Valerie Hahn - BCC
James Nortz - Witco
Richard Dulcey - ERM
Paul Fahrenthold - Fahrenthold
William Mercurio - Langan
Marc Gold - Manko, Gold & Katcher

ORIGINAL
(Red)

RESPONSE ACTION REPORT
HALBY CHEMICAL SUPERFUND SITE
WILMINGTON, NEW CASTLE COUNTY, DELAWARE
EPA DOCKET NO. 111-95-55-DC

VOLUME 1

PREPARED FOR:

WITCO CORPORATION
ONE AMERICAN LANE
GREENWICH, CONNECTICUT 06831

28 JUNE 1996
2061604

Langan
Engineering and Environmental Services

River Drive Center 1, Elmwood Park, NJ 07407 ◆ (201) 794-6900 AR305954

ORIGINAL
(Red)

TABLE OF CONTENTS

ORIGINAL
(Red)

TABLE OF CONTENTS - (Continued)

ORIGINAL (Red)

TABLE OF CONTENTS - (Continued)

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

ORIGINAL (Red)

TABLE OF CONTENTS - (Continued)

ORIGINAL
(Red)

TABLE OF CONTENTS - (Continued)

ORIGINAL (Red)

DATA REFERENCE SHEETS

Test Pit	Sample No(s).
TP-1	048-049
TP-2	050-051
TP-3	052-053, 062 (Dup-1)
TP-4	054-055
TP-5	056-057, 063 (Dup-2)
TP-6	058-059
TP-7	111-112
TP-8	113-115
TP-11	116-117, 121 (Dup-5)
TP-12	088-089
TP-13	118-119
TP-18	120, 125, 128 (Dup-6)
TP-21	126-127
TP-23	132
TP-24	072-073
TP-25	090-091
TP-26	109-110
TP-27	092-095
TP-28	067-069
TP-29	070-071
TP-30	099, 104, 105 (Dup-4)
TP-31	100-103
TP-32	074-075
TP-33	076-077, 078 (Dup-3)
TP-34	136-138, 142 (Dup-7)
TP-35	139-140, 143 (Dup-8), 144 (Dup-9)
TP-36	141, 145 (Dup-10)
TP-37	163-164
TP-38	160-162, 165 (Dup-12)
TP-39	153-154
TP-40	151-152, 156 (Dup-11)
TP-41	149-150, 155

ORIGINAL (Red)

DATA REFERENCE SHEETS - (Continued)

Test Boring	Sample No(s).
LB-1	171-175, 221 (Dup-13)
LB-2	176-179, 222 (Dup-14)
LB-3	180-184
LB-4	185-189
LB-5	190-193, 225 (Dup-17)
LB-6	194-198, 226 (Dup-18)
LB-7	199-204, 223 (Dup-15)
LB-8	205,209, 224 (Dup-16)
LB-9	210-215
LB-10	216-220

1.0 INTRODUCTION

Langan Engineering and Environmental Services, Inc. (Langan), on behalf of the Witco Corporation (Witco), has prepared this Response Action Report (RAR) documenting response actions implemented by Witco at the Halby Chemical Site (Halby Site) located in New Castle County, Delaware. A site location map is provided on Figure 1. The response actions were performed to satisfy the requirements of the Administrative Order for Removal Response Action (Order) for the Halby site.

Pursuant to Section 106 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986, 42 U.S.C. 9606, the United States Environmental Protection Agency (USEPA) issued a unilateral Administrative Order (Docket No. III-95-55-DC), signed 20 July 1995 and effective 25 July 1995, which ordered Witco to perform removal activities at the Halby site. The objectives of the Order and the specified response activities presented therein were to: protect the public health and welfare and the environment by ensuring that a proper removal response action was performed to abate, mitigate and/or eliminate the release or threat of release of hazardous substances at the site; isolate utilities from hazardous media; stabilize highly contaminated soils and sludges; properly dispose of hazardous substances, as appropriate; and take measures to prevent migration of hazardous substances from the site.

Pursuant to the Order, Witco prepared a Response Action Plan (RAP) specifying the procedures by which the objectives and requirements of the Order would be achieved. The RAP was submitted to USEPA on 8 August 1995 and again on 1 September 1995 in revised form, and was provisionally accepted by USEPA on 20 October 1995 conditioned upon Witco's consideration of the government's comments. A request for a two week extension to respond to the government's comments was submitted to USEPA in Witco's letter of 1 November 1995. A final revised version of the RAP, including consideration of all previous government comments, was submitted to USEPA on 20 November 1995.

The scope-of-work presented in the RAP was revised during the course of the RAP implementation. Proposals and notifications of RAP-related work items were submitted to USEPA, and bi-weekly progress reports were prepared identifying activities completed during the previous two weeks, activities planned for the next two weeks, problems encountered and any modifications to the RAP. Submittals to USEPA during the RAP implementation included, but were not limited to, the documents listed below. The listed documents are referenced throughout this report as each applies.

- 18 August 1995 - Langan letter to USEPA presenting Drainage Area Site Security Plan;

- 23 August 1995 - Witco letter to USEPA providing notification of site mobilization and fence installation;
- 28 August 1995 - Langan memo to Witco (and USEPA) presenting the first water main investigation sampling plan;
- 14 September 1995 - Langan memorandum to USEPA and DNREC providing notification of proposed water main, drainage ditch and sump area investigations;
- 1 November 1995 - Witco letter to USEPA requesting a two week extension for submittal of the RAP;
- 29 November 1995 - Langan letter to USEPA providing notification of sampling activities in the water main, drainage ditch and sump areas, implementation of storm water controls and transfer of stockpiled soil to the fenced drainage ditch area;
- 4 December 1995 - Langan letter to USEPA providing notification of fence installation activities;
- 10 January 1996 - Langan letter to USEPA confirming telephone conversation of 27 December 1995 and providing notification of additional test pit excavation and capping of drainage ditch;
- 25 January 1996 - Langan letter to USEPA providing notification of additional test pit excavation and soil boring activities;
- 22 February 1996 - Langan letter to USEPA requesting a joint inter-agency meeting to discuss wetland issues at the site;
- 11 March 1996 - Langan letter to USEPA requesting a change in the progress report schedule requirements;
- 13 March 1996 - Langan letter to USEPA requesting a schedule change for submittal of the RAR, Risk Assessment and Treatability Study;
- 25 March 1996 - Langan letter to USEPA presenting the proposed sampling methodology for collection of samples for use in the treatability study;
- 29 March 1996 - Witco Screening Treatability Study work plan presenting procedures for performing the treatability study;
- 30 April 1996 - Witco letter report to USEPA presenting preliminary waste classification results for the contaminated site soils; and
- 8 May 1996 - Witco Progress Report to USEPA presenting the treatability study progress to date.

USEPA responses to various RAP-related proposals and notifications included, but were not limited to, the following documents:

- 20 July 1995 - Administrative Order for Removal Response Action ordering Witco to perform a response action at the Halby Site;

- 24 July 1995 - USEPA letter to Phillips, Goldman & Spence, P.A. confirming the effective date (25 July 1995) of the Order;
- 10 August 1995 - USEPA letter to Witco confirming receipt of the 8 August 1995 RAP, and requesting implementation of site security measures by 28 August 1995;
- 18 August 1995 - USEPA letter to Witco accepting Witco's selected fence contractor;
- 18 August 1995 - USEPA letter to Witco presenting the government's comments to the 8 August 1995 RAP;
- 21 September 1995 - USEPA letter to Witco confirming receipt of the 1 September 1995 RAP;
- 20 October 1995 - USEPA letter to Witco presenting the government's comments to the 1 September 1995 RAP;
- 3 November 1995 - USEPA letter to Witco accepting Witco's 1 November 1995 request for a two week extension for submittal of the RAP;
- 1 December 1995 - USEPA letter to Witco confirming receipt of Witco's Field Sampling Plan and encouraging Witco to begin field activities on 4 December 1995 as per Langan's letter to USEPA of 29 November 1995;
- 12 January 1996 - USEPA memorandum commenting on the proposed contaminant-of-concern toxicity/soil cleanup levels for the Halby site;
- 2 February 1996 - USEPA memorandum summarizing the results of a November 1995 sampling assessment at and around the Halby site;
- 5 February 1996 - USEPA letter to Witco commenting on Witco's risk assessment for the site and accepting Witco's selected drilling contractor;
- 19 March 1996 - USEPA letter to Langan accepting the proposed schedule revisions (submitted on 13 March 1996) contingent upon incorporation of USEPA's revisions; and
- 3 April 1996 - USEPA memorandum to the Risk Reduction Engineering Laboratory requesting assistance in reviewing Witco's proposed Treatability Study Work Plan.

Based on a review of data obtained prior to preparation of the RAP, Witco determined that the most effective approach to comply with the Order was to initially focus the investigation in the area of the site's drainage system, and then evaluate impacts on the remainder of the site. The focus of the RAP included the former sump area, sump overflow area, drainage ditch area, and the water main located along the northeast boundary of the site. An additional investigation of subsurface soils in the process plant area was subsequently proposed and performed during implementation of the RAP.

1.1 Purpose of Report

The purpose of this RAR is to document Witco's implementation of the RAP and performance of the work items specified in the Order. The work items specified in the Order included:

a. Provide site security;
b. Provide fire protection;
c. Control stormwater and other water;
d. Minimize fugitive emissions;
e. Isolate water main, utilities, and services;
f. Perform a treatability study;
g. Evaluate soil cleanup levels;
h. Stabilize contaminated soils, sediments, and sludges;
i. Provide for proper disposal of materials which cannot be remediated in-situ;
j. Conduct post excavation and/or treatment sampling;
k. Provide Site-Specific Health and Safety Plan (HASP);
l. Obtain a Hazardous Waste Generator Identification Number;
m. Minimize exposure of aquatic species;
n. Provide schedule;
o. Backfill excavated areas; and
p. Provide post-removal maintenance.

As of the completion date of this RAR, Witco was continuing with a treatability study to determine acceptable methods of treating the site soils, and evaluating waste removal/remedial options to address the contaminated soil. Based on the results of the treatability study and the waste removal/remedial option evaluation, a remediation work plan will be prepared describing the most appropriate method of treating the contaminated site soils. A Treatability Study Report, Waste Removal/Remedial Option Report, and remediation work plan will be submitted to USEPA in accordance with the project schedule.

Because the most appropriate remedy for the site has not yet been selected, certain of the work items specified in the Order could not be performed prior to submission of this RAR. Items e; f; h; i; j; m; o; and p will be completed, as applicable, in accordance with the project schedule. Item e has been partially addressed through notice and special procedures implemented by the water company, and item f is in progress.

1.2 Organization of Report

This RAR is comprised of four sections. Section 1, Introduction, discusses the purpose and organization of the report, provides a description of the site, and summarizes previous site investigations and on-site activities.

Section 2, Environmental Setting, summarizes environmental conditions at and around the site including land uses, geologic conditions and hydrogeologic conditions.

Section 3, Response Action Plan Implementation, discusses Witco's 1995/1996 implementation of the RAP. Site mobilization, the collection and analysis of soil, groundwater and air samples, and the implementation of each work item specified in the Order and listed in Section 1.1 of this report are discussed.

Section 4, Summary and Conclusions, reviews implementation of the work items specified in the Order and presents conclusions drawn from that information.

The RAR is contained within 22 volumes. Volume 1 contains the text of the report and tables, figures and appendices presenting supplemental information. Volumes 2 through 19 contain laboratory analytical data packages for the soil, groundwater and air samples collected during the RAP implementation. Volumes 20 through 22 contain data validation reports for the analytical data.

1.3 Site Description

The Halby Chemical site consists of a triangular piece of land covering approximately 14 acres in Wilmington, New Castle County, Delaware. The site is located in an industrialized area near the Port of Wilmington and is bordered to the northeast, northwest and south by the Conrail railroad, Interstate 495 and Terminal Avenue, respectively. A site location map is provided on Figure 1. A site plan is provided on Figure 2.

The fenced area at the south corner of the site constitutes the Halby Chemical Facility, also referred to as the process plant area, which covers approximately 1.5 acres. In 1995, USEPA performed an emergency removal action at the process plant area during which approximately 50 aboveground storage tanks, one underground storage tank, associated piping, drums and machinery were decontaminated and removed from the site. A steel structure containing inactive reactors and piping was also demolished and removed. Chemical bottles and gas cylinders were removed from an onsite abandoned laboratory. An onsite concrete sump and buried chemical bottles were also removed. The major components remaining within the process plant area include a three story brick building containing a warehouse and office space, a 20 foot by 30 foot one story cinder block building formerly serving as the plant's pump house, a railroad spur and various concrete foundations and footings associated with the demolished structures. The process plant area, warehouse and other portions of the site are currently used as storage areas by an on-site pallet recycling business.

The Halby site is also occupied by several structures and businesses located on the southern and western sides of the site along Terminal Avenue. These other facilities include a warehouse and outdoor storage area for steel products, a truck stop and refueling facility, three or four residential trailers, an auto repair and tire repair facility, and assorted parking and vehicle storage areas.

Remedial work at the Halby site was initially organized by USEPA into two operable units. Operable Unit No. 1 (OU-1) addresses the soil contamination within the former process plant area of the site. Operable Unit No. 2 (OU-2) addresses soil contamination on the remainder of the site as well as contamination of the air, groundwater, surface water and sediment at the site.

1.4 Site History

The Halby Chemical Facility was owned and operated by the Halby Chemical Company from 1948 to 1977 as a chemical production facility. The company's three principal products were ammonium thiocyanate, ammonium thioglycolate and isooctyl thioglycolate. Since the time that the Halby Chemical Facility began operations, the land area currently comprising the Halby site has been owned and operated by several entities. A complete discussion of the ownership history of the site is presented in Witco's 22 December 1995 Preliminary Site Assessment Report (PSA) for the Halby site.

The majority of the site, including the existing lagoon and surrounding area and the drainage ditch area, was owned until 1969 by the Pyrites Company. A portion of the site was reportedly used by Pyrites until 1969 to store pyrite ore for the production of sulfuric acid. In 1969, the lagoon area and the drainage ditch area were purchased by the Halby Chemical Company, which had owned the process plant area since 1948. In 1972, the Halby Chemical Company merged with Argus Chemical Company, a wholly-owned subsidiary of the Witco Corporation. Chemical production activities continued at the site under Witco ownership until the plant closed in 1977.

Brandywine Chemical Company, the most recent owner, purchased the property from Witco in 1977. Historical aerial photographs of the site dated 1940 to 1995 indicate a progressive filling of the lagoon and drainage ditch prior to 1977 and a significant amount of filling after 1977.

Brandywine operated the site as a bulk chemical receiving and distribution facility until 1995, when operations were terminated in conjunction with USEPA's removal action. During Brandywine's operations, bulk chemicals were shipped to the site via rail or trucks and stored outside in aboveground storage tanks. The chemicals were later repackaged into empty drums and stored either in the warehouse or outside within the fenced area.

From 1948 to 1964, cooling water, surface water runoff and process water from the Halby facility were discharged into the drainage ditch located along the northeast border of the process plant area. Liquids from the ditch flowed into the on-site lagoon. The lagoon originally drained through a tidal marsh southeast of the site into the Lobdell Canal and subsequently into the Christina River. From 1964 to 1972, the process water was discharged to the county sanitary sewer system and only cooling water and stormwater entered the lagoon. By 1975, Witco was periodically diverting the wastewater flow from the county sewer system to a pilot process wastewater treatment system. The treated wastewater was discharged to the lagoon. Production operations and process and cooling water discharges at the site ceased in August 1977, after which the site served only as a receiving and distribution facility. At some time between May 1977 and June 1983, the northwest bank of the lagoon was breached permitting the lagoon to drain through the drainage ditch along I-495 to the Christina River.

In 1986, after several environmental investigations of the Halby site and surrounding areas, the site was placed on the National Priorities List based on high concentrations of organic and inorganic contaminants found in site soils, surface water, sediments and groundwater.

1.5 Previous Site Investigations

The Halby site and the surrounding area have been investigated by USEPA, the State of Delaware's Department of Natural Resources and Environmental Control (DNREC) and the City of Wilmington. Previous site investigations are summarized below.

In December 1983, DNREC prepared a Preliminary Assessment of the Halby Chemical Site under the Emergency and Remedial Response Information System (ERRIS). According to the assessment, nearby residents had complained about lagoon overflow, hydrogen sulfide - like odors, and numerous spills.

In March 1984, a USEPA FIT III Team performed a site inspection of the facility. Analysis of soil samples collected from the tank and drum storage areas revealed high concentrations of volatile organic and semi-volatile organic compounds and metals. Aqueous and sediment samples from the lagoon outfall indicated migration from the site of various contaminants. Groundwater sampling and analysis revealed that the groundwater underlying the site had been contaminated.

In February 1985, DNREC conducted a Preliminary Hydrogeologic Investigation at the salt piles along I-495. DNREC concluded that leachate from the salt piles had contaminated the groundwater locally. High levels of iron, manganese, sulfates, sodium and chloride were found in groundwater samples collected from the vicinity of the salt piles.

In March 1985, USEPA resampled groundwater at the Halby Chemical Site. Analysis of the samples revealed that most of the cyanide discovered during the March 1984 sampling was actually thiocyanate, a compound that was manufactured at the Halby Chemical Facility.

In August 1986, the City of Wilmington commissioned a geotechnical investigation of the bulk storage area adjacent to the Halby Chemical site. The investigation revealed that groundwater at the bulk storage area was contaminated with various volatile organic and semi-volatile organic compounds and metals which may have contributed to the groundwater contamination at the Halby Chemical site.

In October 1988, AEPCO, Inc. under contract to EBASCO Services, Inc. initiated a Remedial Investigation of the Halby Chemical Site as part of a Remedial Investigation/Feasibility Study (RI/FS). The work was performed under contract for the USEPA. The RI included investigations of the air, soil, sediment, surface water, groundwater, wetlands and biota at and in the vicinity of the site. Samples were collected from each medium and submitted for chemical analyses.

In September 1990, a Final Remedial Investigation (RI) Report for the Halby site was completed by AEPCO and Ebasco. Based on information and observations gathered during the RI and the results of chemical analyses, USEPA determined that site-related contaminants are present in the on-site soils, lagoon sediments, groundwater and surface water. The identified contaminants included metals, volatile organic compounds, semi-volatile organic compounds and cyanide. USEPA further determined that these contaminants were migrating off-site via the surface water, groundwater and sediment pathways, and that the potential for migration of volatile organic contaminants was possible via the air pathway. Following completion of the RI Report, the remedial work at the Halby site was organized into two operable units, OU-1 and OU-2.

In June 1992, Langan, on Witco's behalf, completed a Remedial Design Work Plan for OU-1 in accordance with the Record of Decision (ROD) and Consent Decree (CD). The individual plans presented in the Remedial Design Work Plan included a sampling and analysis plan outlining a program of surface soil sampling and analysis of the Halby Chemical Site to identify areas of the site requiring remediation. The samples were to be collected from a grid pattern and analyzed for arsenic, total chromium, hexavalent chromium and carcinogenic polycyclic aromatic hydrocarbons (CPAH's). Trivalent chromium was to be calculated. The Remedial Design Work Plan also included a Quality Assurance Project Plan, a Health and Safety Plan, and a Treatability Study Workplan outlining a program to evaluate methods of stabilizing surface soils at the Halby site.

In April 1993, Langan completed a Preliminary Remedial Design Report for Witco Corporation which discussed the results of Langan's Soil Grid Survey Sampling and Analysis Plan.

In April 1993, Langan completed a Treatability Study Report for Witco Corporation presenting the results of Langan's Treatability Study Work Plan, which included mixing the contaminated soil with asphalt.

In March 1995, CH_2M Hill, under contract to USEPA, completed a Revised Remedial Investigation (Revised RI) for OU-2 of the Halby Site. The Revised RI identified sources of site contamination; defined potential contaminant migration pathways; identified contaminants-of-concern; and assessed risks to human health and the environment. The Revised RI was updated and reissued in May 1996.

In 1995, USEPA implemented an emergency removal action at the process plant area. Under the removal action, Brandywine's operations were terminated, and tanks, piping, structures, and equipment were removed from the site. Hundreds of chemical bottles were removed from a four-room chemical laboratory located in the warehouse building. A concrete sump located at the north corner of the process plant area was excavated; during which, ignitable and reactive soils and buried chemical bottles were discovered. Approximately 160 cubic yards of contaminated soil were excavated during the removal action and stockpiled in the process plant area. The chemical bottles were excavated and removed.

In August 1995, Langan implemented a Response Action Plan (RAP) at the Halby site. The objectives of the RAP were to implement site security, supplement existing sampling data, identify and evaluate remedial alternatives for the site, assist in the development of action levels and evaluate the condition of the water main located along the west border of the site. The investigation included the excavation and sampling of 32 test pits located in the drainage ditch area, along the water main and in the sump area, and the completion and sampling of 10 soil borings in the process plant area. As part of the investigation, the drainage ditch area was cleared and regraded, covered with a high density polyethylene liner (HDPE) and backfilled with clean fill. A soil dike was also constructed in the breached area of the northwest bank of the lagoon to obstruct tidal influence in the lagoon. The soil excavated during the 1995 USEPA removal action and stockpiled in the process plant area was transferred to a fenced area near the drainage ditch and covered with HDPE. This report documents the implementation and results of the RAP.

The Revised RI for OU-2 was updated and reissued in May 1996.

2.0 ENVIRONMENTAL SETTING

The following descriptions of the Halby site and surrounding areas are based on information presented in the AEPCO/Ebasco 1990 RI Report, CH_2M Hill's 1995 Revised RI Report for OU-2 and Witco's 1995 PSA for the site.

2.1 Surrounding Area

As previously described, the site is located in an industrialized area near the Port of Wilmington and is bordered by the Conrail Railroad, Interstate 495, and Terminal Avenue. Historic maps show that the surrounding area has been industrialized probably since the late 1800's, with a variety of foundries or factories located near the site. Nearby industries included the Eastern Malleable Iron Company/Forbes Steel Company (still in operation) located north of the site, the Pyrites Company located along the Christina River to the east, the Christiana Iron Company also located to the east along the Christina River, the Lobdell Car Wheel Company located to the southeast, and the American Smelting Company located approximately 1,000 feet southeast of the site.

Current land uses in the site area include the bulk storage of salt to the northwest, storage of coal and petroleum coke immediately to the east, and various industries to the south and west including an asphalt plant, truck wash, general contracting companies and a Delaware Department of Transportation (DOT) equipment storage yard.

A visual reconnaissance of the accessible portions of the properties adjacent to and surrounding the site was performed by Witco as part of the PSA. According to the PSA, the Interstate 495 (I-495) right-of-way (R.O.W.) located along the western perimeter of the subject property was inaccessible because the R.O.W. was densely vegetated with brush and trees.

The Conrail Railroad R.O.W. located along the eastern boundary of the site consists of a single set of tracks on a raised base of gravel ballast. A dirt access road runs parallel to the western edge of the tracks. The edges of the R.O.W. contain areas of exposed soil and dense vegetation. A water-filled drainage ditch was located at the border between the subject property and the railroad R.O.W. High tension electrical towers (Delmarva Power) are located along both the western and eastern boundaries of the R.O.W. A pile of white crystalline or ash-like material measuring approximately two feet wide, by three feet long and six inches high was observed on the railroad tracks. The presence of the material appears to have resulted from a railcar spill.

Located along the southern side of Terminal Avenue are (from east to west): the Dover Equipment Machine Company asphalt production facility; the offices of Diamond State Masonry, Inc.; the J.M.J. Truck Wash and Talley Brothers General Contractors equipment storage yard; the Interstate 495 R.O.W.; and a Delaware DOT materials and equipment storage area. Along the eastern side of the Conrail Railroad R.O.W. lies a large stockpile of a powdered black carbon-like material. A worker on this site reported that this material was ash generated at a nearby Texaco refinery. The worker also reported that groundwater monitoring wells were maintained on the property to monitor the potential impact of the ash on the groundwater. As reported in the FS Report for OU-1 (April 1991) and the ROD (June 1991), this area was previously used for storage of coal and petroleum coke. In the City of Wilmington Study (Duffield Associates, 1986) groundwater contamination by cobalt, nickel, strontium and high concentrations of surfactant was attributed to storage of these materials.

The I-495 R.O.W. extends approximately 500 feet west of the subject property. The road bed is elevated approximately thirty feet above the grade of the site. The reconnaissance of the surrounding areas was not extended beyond the eastern boundary of I-495; however, an area used for storage of salt piles was identified to the west of I-495 in the FS Report for OU-1 and ROD. According to these reports, a DNREC study concluded that leachate from the salt piles had contaminated groundwater locally. Groundwater analysis conducted as part of the DNREC study detected elevated concentrations of sodium chloride, iron, manganese and sulfates. According to the study, the presence of iron and sulfates may be attributed to the storage of coal and slag at or near the site in the past.

The site topography is relatively flat, with surface elevations varying from approximately above 10 feet mean sea level (MSL) on the south and west sides of the site to approximately five feet MSL at the northeast corner. Until Witco's implementation of the RAP, surface water bodies located on the site included a drainage ditch which originated at the northeast corner of the process plant area and a lagoon at the northeast corner of the site. Surface water runoff at the site generally drained either through the drainage ditch and into the lagoon, or directly into the lagoon. Water from the lagoon had drained through a breach in its northwest bank, into a drainage ditch along I-495, and then into the Christina River. Due to the direct hydraulic connection with the Christina River, both the lagoon and on-site drainage ditch had been under tidal influence, with water levels fluctuating two to three feet with each tidal cycle. As described in Section 3.5 of this report, during the RAP implementation the onsite drainage ditch was covered and filled with clean soil and a soil dike was constructed across the breached section of the lagoon bank obstructing the direct hydraulic connection with the Christina River.

2.2 Geologic Conditions

This section summarizes the findings of CH2M Hill's 1995 Draft Revised RI report for OU-2 and presents geologic data obtained during Witco's RAP implementation. A complete discussion of the relevant geology is presented in Section 3.4 of the RI for OU-2.

2.2.1 Regional Geology

The Halby site is located in the Coastal Plain Physiographic Province which consists of interbedded unconsolidated and semi-consolidated sands, silts, clays and gravels. The Coastal Plain deposits rest on the underlying igneous and metamorphic crystalline bedrock and varies in thickness from zero feet at the Fall Line to several hundred feet at the coast line. The Fall Line trends northeast-southwest and marks the contact between the Coastal Plain deposits and the bedrock exposed in the Piedmont Physiographic Province. The Halby site is located approximately 1.25 miles south of the Fall Line. The Coastal Plain deposits in the New Castle County area are present at thicknesses in excess of 500 feet.

The unconsolidated geologic formations underlying the site are represented (in ascending order) by the Potomac Formation, the Columbia Formation, and the Recent Age sediments. The crystalline bedrock which underlies the entire region is composed of schists, granites, gneisses and gabbros and is overlain by their weathered products to thicknesses in excess of 100 feet.

The Potomac Formation is probably fluvial in origin and consists primarily of clays and silts with interbedded sand and some gravel. This formation may be divided into upper and lower units on the basis of trace mineral zones, water bearing sands and confining layers. However, the lithologic units of the Potomac Formation vary considerably in horizontal extent and thickness making subdivision of the formation difficult. The Potomac Formation varies in thickness from approximately 50 feet to 80 feet in the vicinity of the site.

The Columbia Formation consists of moderately to poorly sorted sand with gravel, silt and clay. The Columbia Formation varies regionally in thickness from zero to over 100 feet.

The Recent Sediments overlie the Columbia and Potomac Formations and typically consist of fine sands, silts, and clays. The Recent Sediments are generally found in valleys eroded into the older Columbia and Potomac Formations. Depending on the depth of the erosion, the Recent Sediments can completely or partially cut off the older formations. Recent Sediments are associated primarily with the Delaware and Christina Rivers and may extend to a depth of 100 feet adjacent to the Delaware River.

2.2.2 Site Specific Geology

Site specific lithologic information was obtained during the installation of soil borings and groundwater monitoring wells at and around the site during preparation of the AEPCO/Ebasco 1990 RI Report and CH_2M Hill's 1995

Revised RI Report for OU-2. In general, the data agreed with published regional information regarding the Potomac, Columbian and Recent Sediments Formations.

Weathered bedrock was encountered at depths of 90 to 103 feet below MSL. The weathered bedrock consisted of variegated silty clay with medium grained sand.

The Potomac Formation was generally encountered at depths of 20 feet to 40 feet below MSL and consisted of fine to medium grained sand, with silt and clay in varying percentages. Two sand units are continuous in the vicinity of the site and are separated by a thick continuous clay. The lower sand unit consists of light blue to light green, fine to medium grained sand in a silt and clay matrix. The upper sand unit consists of gray, fine to medium grained sand, with occasional lenses of silt and gravel. The clay layer separating the two sand units varies from approximately ten feet to 25 feet thick and consists of red to gray clay or silty clay.

The Columbia Formation overlies the Potomac Formation and was generally encountered at the surface to depths of 30 feet below MSL. The Columbia Formation consist of an orange-brown fine to coarse grained sand, with an occasional gravel layer, silt and clay. A discontinuous layer of red to gray silt and clay was observed indicating the division between the Potomac and Columbian Formations.

Recent Sediments overlie the Columbia Formation. These sediments consist primarily of organic rich silts and clays and peat. They are thickest adjacent to the Christina River where they measure over 40 feet, and become thinner away from the river until they eventually become non-existent in the vicinity of Terminal Avenue.

In the vicinity of the site, a thin layer of fill material generally overlies the surficial sediments. The fill material consists of sand, gravel, concrete, wood, and coal/coke. On-site, the fill material was encountered to depths of 10 feet in portions of the former lagoon.

2.3 Hydrogeologic Conditions

This section summarizes the findings of the AEPCO/Ebasco 1990 RI Report and CH_2M Hill's 1995 Draft Revised RI Report for the Halby site. A complete discussion of the relevant hydrogeology is presented in Section 3.8 of the 1990 RI Report and Section 3.5 of the 1995 Draft Revised RI Report.

2.3.1 Regional Hydrogeology

According to the RI Report (AEPCO/Ebasco, 1990):

> "Regionally, both the Potomac and Columbia Formations are developed as groundwater supply sources. However, within a three-mile radius of the site only the lower Potomac Formation is utilized for public and industrial water supplies."
>
> "The Potomac Formation is generally subdivided into two or three hydrologic units (aquifers) based on the vertical and horizontal distribution of the sands within the Formation... Because of the dip of the coastal plain sediments, each hydrogeologic zone subcrops at the surface. The areas where these sands or aquifers reach their updip limits or come close to the surface (within three miles south of the site) are the primary recharge areas of the aquifers. The water bearing sands of the Columbia Formation also provide recharge to the underlying sands of the Potomac Formation."

2.3.2 Site Specific Hydrogeology

Based on the conclusions of the 1990 RI Report, the three water bearing formations encountered beneath the site are classified as the upper and lower Potomac aquifers and the Columbia aquifer. The terms upper and lower in respect to the Potomac aquifers refer to the relative positions of the aquifers at the site. The findings of the 1990 RI and 1995 Draft Revised RI concerning the three formations at the Halby site are summarized below.

<u>Columbia Aquifer:</u> The sands and gravels of the Columbia Formation represent the regional water table aquifer in New Castle County. Based on soil boring logs compiled during monitoring well installations at the site, the thickness of

the Columbia aquifer at the Halby Chemical site varies from 10 feet to 30 feet. Shallow groundwater was encountered between three and five feet above mean sea level (MSL) at the site, and groundwater flow was generally to the northeast, towards the Christina River. Aquifer tests conducted in the Columbia aquifer indicate that its hydraulic conductivity ranges from approximately 0.9 ft/day to 1.8 ft/day. The aquifer's groundwater velocity was calculated to be 2.4 ft/year.

Potomac Aquifer: Based on soil boring logs compiled during monitoring well installation at the site, the thickness of the upper and lower Potomac aquifers range from 10 feet to 40 feet and from five feet to 20 feet, respectively. Groundwater was encountered in the upper Potomac aquifer at elevations of 1.5 feet above MSL to 6 feet above MSL; groundwater elevations in the lower Potomac formation ranged from 1.9 feet above MSL to 1.3 feet above MSL.

Groundwater flow in the upper Potomac aquifer was generally to the north-northeast, towards the Christina River. Aquifer tests conducted in the upper Potomac Formation indicate that its hydraulic conductivity ranges from approximately 15.3 ft/day to 19.3 ft/day. The aquifer's groundwater velocity was calculated to be 30.5 ft/year.

Groundwater flow in the lower Potomac aquifer was generally to the south-southeast. The difference in groundwater flow direction between the lower and upper Potomac aquifers indicates a hydraulic separation of the aquifers caused by the intervening clay. Aquifer tests conducted in the lower Potomac Formation indicate a hydraulic conductivity of approximately 2.6 ft/day. The aquifer's groundwater velocity was calculated to range from 4.3 ft/year to 5.7 ft/year.

2.4 Fill Materials

Based on published geologic literature, historical aerial photographs and site investigations, it is evident that the Halby site and surrounding areas have experienced a significant degree of landfilling activity. This section discusses the available information concerning the fill materials in order to more fully characterize site conditions.

According to the USGS Soil Survey of New Castle County, the natural soils on-site and north, east and south of the site typically have been covered by up to 18 inches or more of fill materials. The fill materials encountered on the Halby site and surrounding areas during the 1990 RI and 1995 Draft Revised RI were described as consisting of sand, silt, gravel, ash, coal, slag, sawdust and construction debris. The construction debris typically consisted of bricks, wood, concrete, metal and plastic. These fill materials were found to depths of 10 feet on site, and to a lesser thickness north, east and south of the site.

Historical aerial photographs of the site reveal that the lagoon originally adjoined the northeast corner of the process plant area. Later photographs show that by 1982, the southern 350 feet of the lagoon had been filled, leaving a drainage ditch leading from the process plant area to the lagoon.

During Witco's RAP implementation, the type of fill encountered varied throughout the site. Fill in test pits excavated along the water main generally consisted of a two-foot thick surface layer of yellow-brown fine sand overlying approximately three feet of dark gray to black sand, gravel, cinders and slag. Little or no debris was encountered; although wood, which appeared to be old shoring, was encountered in two test pits adjacent to the drainage ditch.

Test pits excavated in the sump area typically contained approximately three feet of fill consisting of sand, silt and gravel. In two test pits, debris was encountered consisting of bricks, wire, rubber, wood and large quantities of broken glass. The former sump location was excavated by USEPA during the 1995 removal action. Although the precise limits of excavation are unknown, it is estimated that 160 cubic yards of soil was excavated and stockpiled on site. The excavation was reportedly backfilled with clean soil.

Within the drainage ditch area, the fill materials typically varied from approximately one to three feet deep in the southern half of the area to approximately six to seven feet deep in the northern half. Fill in the southern half of the area generally consisted of: sand, silt and gravel with small quantities of debris including wood, concrete, bricks and plastic. Fill in the northern half of the area generally consisted of: sand, silt, gravel and moderate to large quantities of debris including wood, metal, tires, pipe, concrete, brick, asphalt and plastic. Boulders, cobbles and large tree limbs were also occasionally encountered. Fragments of silver-gray metallic crystalline rock and slag, which appeared to be a metallic by-product, were also recovered throughout the drainage ditch area.

Soil borings completed throughout the process plant area generally showed subsurface soils consisted of five to seven feet of gray to orange-brown sand and silt overlying a black sand and silt. The black sand and silt was encountered throughout the process plant area with the exception of the extreme southern corner of the site. Concrete footings and foundations are located throughout the area, and concrete debris was occasionally encountered to two foot depths. Fill and debris of the type found in the sump and drainage ditch areas was not encountered in the process plant area.

3.0 RESPONSE ACTION PLAN IMPLEMENTATION

This section discusses the implementation of the RAP and the performance of work items specified in the Order. The completion and results of additional soil, groundwater and air sampling proposed in the RAP are also discussed. Photographs documenting work performed during implementation of the RAP are included in Appendix A.

3.1 Site Mobilization

Upon receiving USEPA's approval of the RAP, a field office was established at the site in a temporary portable trailer. USEPA was notified of the proposed mobilization in Langan's letter of 23 August 1995. The field office included office space for Witco and USEPA personnel, storage space for equipment and supplies, communications, and sanitary facilities. Prior to implementing field activities at the site, on-site and off-site property access agreements were obtained, and markouts of utilities within the work area were performed.

3.1.1 On-Site Property Access

Approval to access the Halby site was obtained from the property owners prior to implementing the RAP. The access agreements included access to the site for the following personnel: USEPA, DNREC, Witco, Witco contractors, subcontractors, utility company representatives and local or county fire officials.

Access to the drainage ditch area and process plant area portions of the site was obtained through a Settlement Agreement and Mutual Release signed between Witco and Brandywine, the current owner of those areas. Access to the lagoon area of the site was obtained from F & H Transport, the current owner. Upon receipt of USEPA's approval of the RAP, the property owners were notified of Witco's intention to begin work. Copies of access agreements were included in the RAP.

3.1.2 Off-Site Property Access

An access agreement with the owner (Conrail) of other property affected by the response action was also obtained. Conrail, entered into an access agreement with Witco for property located in the response action area. A copy of the access agreement was included in the RAP. United Water and Delmarva Power were notified in writing and verbally of work to be performed. Drawings of work areas onsite were supplied to the utility companies, along with emergency contacts. Access agreements with the utility companies were not necessary because the utilities are located on Conrail property.

3.1.3 Utility Markout

Prior to implementing the RAP, the utilities located in the response action area were located. The Delaware Utility Markout Service was contacted for a complete underground utility markout within the fenced drainage ditch area. United Water, Conrail, Delmarva Power and Texaco Pipeline were also contacted to provide utility markouts and to obtain drawings showing locations, design diagrams and any procedures to be followed during excavation and/or remediation near the utilities. Texaco Pipeline would not provide any drawings and would only check that proposed excavation areas were not near their pipeline. From verbal conversations, the pipeline may be located near I-495. Conrail, United Water, and Delmarva Power were also notified of identified site contaminants which may impact their respective utilities. Delaware DOT was also contacted for construction maps for I-495.

Other utilities investigated include underground pipes along Golding Avenue encountered by USEPA in 1995 during the removal action. The pipes were researched by Witco and thought to be overflow pipes from aboveground storage tanks at the Halby facility.

3.2 Sampling and Analysis Plan Implementation

In accordance with the requirements of the Order, additional data was required concerning the nature and extent of site contaminants. A Sampling and Analysis Plan (SAP) was presented in the RAP to supplement existing data in order to: further define "clean" areas; evaluate remedial alternatives for the site; assist in the development of action levels; evaluate the condition of the water main; and otherwise aid in satisfying the requirements of the Order. The SAP consisted of a Field Sampling Plan (FSP) and a Quality Assurance Project Plan (QAPP) which provided sample collection and quality control procedures and rationales for environmental investigations at the site.

The FSP defined the methods to be used for collection and analysis of environmental samples during the water main, drainage ditch and sump area investigations. The plan documented field sampling objectives, procedures and rationales, and identified the analytical parameters and methodologies to be performed on the collected samples.

The QAPP established the sampling and analysis protocols and quality assurance procedures for data collection and data analysis activities during implementation of the RAP. The plan provided assurances that sample collection and analysis adhered to the quality control policies stipulated in the USEPA Region III and DNREC quality assurance protocols.

The sampling investigations proposed in the SAP included two water main investigations, a drainage ditch delineation and a sump area delineation. An additional investigation, a process plant area soil boring investigation not formerly proposed in the SAP, was also performed during the RAP implementation. Notification of the soil boring investigation and a description of the proposed sampling procedures was submitted to USEPA in Langan's letter of 25 January 1996.

The specific sampling and quality assurance procedures implemented during the water main, drainage ditch, sump area and process plant area investigations are described below. The implementation and results of each investigation are also discussed. Analytical results are discussed only for identified site-related contaminants-of-concern. Since USEPA has not approved Witco's proposed contaminants-of-concern and soil cleanup levels (See Section 3.9 of this report), the analytical results are discussed for contaminants-of-concern identified in previous investigations. Based on a risk assessment performed by CH_2M Hill in the updated Revised RI for OU-2 (issued in May 1996), the soil and sediment contaminants-of-concern were identified as the metals arsenic; beryllium; copper; and manganese, and the volatile organic compound carbon disulfide. The semivolatile organic compounds benzo(a)pyrene and benzo(k)fluoranthene and the metal antimony were previously identified as contaminants of concern in the 1995 Revised RI for OU-2. The discussion of results in this report includes the contaminants of concern identified in both the 1995 and

1996 versions of the Revised RI for OU-2. No soil cleanup levels have been established for these site contaminants for OU-2.

All sample locations and the complete analytical results obtained during the water main, drainage ditch and sump area investigations are shown on: Figure 3 (volatile organic compounds); Figure 4 (base neutral compounds); Figure 5 (pesticides, herbicides and PCBs); and Figure 6 (metals and cyanide compounds). Carbon disulfide sampling results obtained during the RAP investigations are shown on Figure 7, and both recent (1995/1996) and historical carbon disulfide results are shown on Figure 8. Both recent (1995/1996) and historical arsenic results are shown on Figure 9. Sample locations and analytical results for the process plant area soil boring investigation are shown on Figure 10 (arsenic). All historic sampling data obtained during previous site investigations is presented in Witco's 1995 PSA for the Halby site.

All laboratory analyses of the environmental samples collected during implementation of the RAP were performed by Envirotech Research, Inc. of Edison, New Jersey. The laboratory analytical data packages are included in Volumes 2 through 19 of this RAR.

3.2.1 Sampling Procedures

The sampling procedures identified in the SAP conformed to the guidelines presented in the document "A Compendium of Superfund Field Operations Methods" (USEPA, 1987) and the American Society for Testing Materials (ASTM) Standard Operating Procedures (SOP). Modifications to the identified sampling procedures were made when necessary based on sampling requirements or field conditions.

Environmental samples were collected using decontaminated sampling equipment to transfer the sample to the appropriate glass or plastic sample container. All sampling equipment was properly decontaminated as described in Section 3.2.1.5 of this report. Each sample container was supplied by the laboratory with any required preservatives already added. Following collection, each sample container was labeled, and the sample was assigned a unique alphanumeric sample number. The samples were immediately placed into clean, insulated coolers and cooled with ice packs. All sample containers for volatile organic analysis were stored in a common cooler, and all sample coolers were stored away from potential sources of contamination.

Information including the location, sample number, date, time, depth, matrix and analyses required for each sample was recorded in a bound field logbook. Combined chain-of-custody/analysis request forms indicating the sample information and requested analyses were completed for each shipment of samples. Prior to shipment, each sample container was cushioned with cardboard or plastic bubble packing, the chain-of-custody was placed inside one of the coolers, and each cooler was sealed with Langan custody seals. The laboratory was contacted as needed for delivery and pick-up of sample coolers, and all samples were delivered to the laboratory within two days of sample collection. All samples were adequately cooled with ice packs until delivery to the laboratory.

3.2.1.1 Soil Sampling Procedures

During the RAP investigations, environmental soil samples were collected from test pits in the water main, drainage ditch and sump areas, and from soil borings in the former process plant area. The test pits were excavated using a tire-mounted or track-mounted backhoe. The soil borings were completed using a drilling rig and consecutively advanced split spoon samplers.

During excavation and soil boring activities, soil removed from each excavation or boring was visually examined for staining and odors and was screened for volatile organic vapors using a photoionization detector (PID). The soil was then classified using the Burmister Classification System, noting color, texture, moisture content and extraneous materials. Each test pit was photographed during excavation and sampling, and each soil boring location was photo-documented.

Environmental soil samples were collected by using decontaminated sampling equipment to transfer the excavated soil to the laboratory-provided sample containers. All soil samples were collected as discrete grab samples. Any preparation of composite samples required was performed at the analytical laboratory. The non-volatile portions of matrix spike/matrix spike duplicate (MS/MSD) quality control samples and USEPA split samples were field homogenized in decontaminated stainless steel bowls prior to placement in the sample containers. When sampling the test pits, soil was collected from the appropriate depth using the backhoe bucket and placed beside the excavation. Care was taken to sample only undisturbed soil which had not contacted the backhoe bucket. All soil samples for volatile organic analysis, except those from the first water main investigation, were preserved using methanol in accordance with DNREC sampling procedures. Soil samples collected during the first water main investigation were not preserved, and procedures were modified to include methanol preservation based upon USEPA/DNREC comments to the RAP.

For health and safety purposes, air quality at each sample location was monitored for site contaminants in accordance with the Health and Safety Plan (HASP) contained in the RAP. Air monitoring data and physical observations such as odors and "soil flashing" were used to evaluate the level of personal protective equipment required by the sampling personnel. The term "soil flashing" is used in this report to described momentary fires observed during excavation of the site soils. The soil flashing apparently resulted from the ignition of volatile vapors emanating from the excavated soil.

The information obtained during the soil sampling activities including field measurements, soil classifications, air monitoring data, sample locations and other observations was compiled into the test pit and boring logs included in Appendix B of this report.

Soil excavated from each test pit or recovered from each soil boring was temporarily staged beside its associated excavation or boring. After sampling, the staged soil was redeposited into the same excavated area.

3.2.1.2 Groundwater Sampling Procedures

One groundwater sample was collected during the RAP implementation from a test pit located along the water main. Groundwater entering the test pit was collected using a decontaminated six-foot long teflon dipper. The groundwater sample was transferred directly to laboratory provided sample containers which were then labeled and stored in an insulated cooler with ice packs.

3.2.1.3 Air Sampling Procedures

Air sampling was performed for health and safety purposes as proposed in the FSP and HASP. Airborne particulate samples for laboratory analysis were collected on the first two full days of field operations and weekly thereafter. The samples were collected from an employee at the highest risk of exposure within the immediate work area and one employee at the highest risk of exposure outside the work area. The two employees were provided with Gilian or Alpha-1 air sampling pumps and laboratory-provided sample canisters. The canisters consisted of plastic cylinders containing filters to catch particulate matter. The sample canisters were attached to the air sampling pump, and the pump flow rates and total pumping times were recorded for later calculation of airborne contaminant concentrations. Upon completion of each day's field activities, the sample canisters were labeled, sealed in plastic bags and stored in an insulated cooler with ice packs for transportation to the laboratory.

3.2.1.4 Quality Control Sampling Procedures

Quality control samples were collected during the field investigations in accordance with the procedures identified in the FSP.

The quality control samples collected included:

- one Matrix Spike (MS)/Matrix Spike Duplicate (MSD) and laboratory duplicate for every sample delivery group (twenty samples);
- one field duplicate for every ten samples;
- one equipment rinsate blank each sample collection day;
- one field blank each sample collection day; and
- one trip blank each sample collection day.

The non-volatile portions of all MS/MSD samples and samples which were split with USEPA Region III and DNREC were field homogenized in decontaminated stainless steel bowls prior to being placed into the appropriate sample containers. The volatile portions of these samples were collected discretely and were not homogenized. All USEPA and DNREC split samples were collected in the presence of and with the assistance of field personnel from CH_2M Hill, the USEPA oversight contractor.

Field duplicate samples were collected from the same locations as their associated environmental samples and were not homogenized. The field duplicates were labeled as sequential samples such that they were treated as laboratory blind duplicates. The location of the blind duplicate was recorded in the field log book and on the test pit or boring log.

Equipment rinsate blanks were collected for each day of sampling by pouring laboratory-provided ASTM Type 2 water over a decontaminated sampling trowel and collecting the rinsate in the appropriate sample container.

Field blanks were collected for each day of sampling by pouring laboratory-provided ASTM Type 2 water directly into the appropriate sample container. Field blanks for volatile organics analysis using methanol as a preservative were prepared by opening the preserved sample container and exposing the container's contents to the ambient air. Field blanks were prepared in the vicinity of a location sampled that day.

Trip blanks were prepared by the laboratory, delivered to the site, and returned unopened for analysis for each day of sampling. Care was taken to place all sample containers for volatile organics analysis into one cooler, thus requiring only one trip blank per day.

3.2.1.5 Decontamination and Waste Management Procedures

All equipment used to collect environmental samples was properly decontaminated by Enviroline Laboratory of West Paterson, New Jersey prior to use. Decontamination procedures consisted of a soapy water wash to remove all solid residues, followed by successive rinses of distilled/deionized water, nitric acid, distilled/deionized water, methanol, and a final distilled/deionized water rinse. The sampling equipment was permitted to air dry following the methanol rinse and the final distilled/deionized water rinse. The equipment was then wrapped in aluminum foil until use. No field decontamination of sampling equipment was performed. All used sampling equipment was sealed in plastic bags and returned to the laboratory.

Decontamination of personal protective equipment (PPE) was performed using two basins, one containing soap and tap water for washing and the other containing tap water for rinsing. The basins were used to clean equipment prior to leaving the work area. Rinse water from the basins was disposed of at the central steam cleaning location described below. Used PPE was placed into plastic trashbags and disposed of as solid waste.

Excavation and drilling equipment used during the investigations was decontaminated after completion of each test pit or soil boring by steam cleaning with potable water. The FSP specified that the steam cleaning was to be performed in the test pit or soil boring area previously sampled so that decontamination fluids would infiltrate into the surface in the same area which was excavated. This aspect of the FSP was modified for test pits TP-1 through TP-36. Following excavation of each of these test pits, the backhoe bucket was cleaned at a central location, at the south end of the drainage ditch. The specified decontamination procedures were also modified on 11 December 1995 for test pits TP-24 and TP-28 through TP-33. Extremely cold weather on that day rendered the steam cleaner inoperable, and the backhoe was decontaminated by scraping gross contamination from the bucket. USEPA was notified of the modified decontamination procedures through the Witco progress report of 22 December 1995.

3.2.1.6 Air Monitoring Procedures

Air quality monitoring performed during the field investigations consisted of monitoring for airborne particulates, volatile organic vapors, and site-specific contaminants.

Airborne particulate monitoring was performed using a MIE Miniram Aerosol Monitor. The instrument was worn by the site health and safety officer, who daily monitored total particulate concentrations in the breathing zone immediately downwind of sampling activities.

Volatile organic vapors were monitored at each sample location using intrinsically safe photoionization detectors (PID). The PIDs were used to monitor air quality within the sampling personnel's breathing zone and downwind of the sampling activities.

The presence of flammable vapors was monitored using a combination combustible gas indicator (CGI) and oxygen meter. The CGI was used to monitor air quality downwind of the sampling location.

Airborne concentrations of site-specific contaminants including: carbon disulfide, hydrogen sulfide, benzene and ammonia were monitored using Dräger tubes. Dräger tubes are thin glass tubes containing contaminant-specific absorptive media. The media changes color based on the presence and concentration of specific contaminants. Dräger tubes were used to monitor the sampling personnel's breathing zone and downwind of the sampling activities.

3.2.2 Investigation of Water Main - First Event

The first water main investigation at the Halby site consisted of the excavation and sampling of six test pits along the 350 foot length of water main which parallels the drainage ditch.. The sampling plan for the first water main investigation was outlined in Langan's memo submitted to USEPA on 28 August 1995. The objective of the investigation was to evaluate the presence, extent and degree of soil contamination (particularly carbon disulfide) near the

16 inch diameter cast-iron water main. The base of the water main was estimated to be approximately 2½ feet to 3½ feet below grade.

The six test pits were excavated and sampled on 29 August 1995. Excavation services were provided by Republic Environmental Systems, Inc. of Bordentown, New Jersey utilizing a CAT 416 EH tire-mounted backhoe. Site supervision and collection of environmental samples was performed by Langan geologists and engineers. All field operations were observed by a representative of ERM, Witco's oversight contractor. No USEPA or DNREC oversight personnel were present. All field activities were conducted in Level D personal protective equipment (PPE).

The six test pits, TP-1 through TP-6, were excavated approximately two feet west of the reported water main location, and at 50 foot intervals along the length of the main. Excavation within two feet of the water main was avoided in order to minimize the potential for damage to the pipe or its protective coating. As proposed in the RAP, the test pits were to be oriented perpendicular to the water main. Due to insufficient room between the security fence and the ditch, the RAP was modified and the test pits were excavated parallel to the water main. The test pits were excavated to dimensions of two feet wide, seven to ten feet long, and a maximum of seven feet deep.

As proposed in the RAP, two to three samples were to be collected from each test pit. Samples were to be collected at the base of the water main, above the water main if contamination was suspected, and from the location above the water table showing the highest PID and/or carbon disulfide Dräger tube reading.

To evaluate the extent of soil contamination, a total of 12 soil samples were collected, two from each test pit. The samples were collected within the five foot to six foot depth interval in each test pit and from the location above the water table with the highest PID and/or carbon disulfide Dräger tube measurements. In all cases, the highest PID and/or Dräger tube measurements were in the upper three feet of soil, which also corresponds to the depth for worker safety, as specified by USEPA.

The samples were submitted for laboratory analysis for the following parameters proposed in the RAP:

- Contract Laboratory Procedure (CLP) Volatile Organic Compounds (VOC);
- CLP Semivolatile Organic Compounds (SVOC);
- CLP pesticides/polychlorinated biphenyls (PCB);
- CLP Metals;
- CLP Cyanide;
- Thiocyanate;
- Weak acid dissociable cyanide (free cyanide);
- Ignitability;
- Corrosivity
- Reactive sulfide; and
- Reactive cyanide.

In addition, a composite sample for each test pit was prepared at the laboratory by compositing a portion of the two samples from each excavation. The composite samples were analyzed for the following parameters proposed in the RAP:

- Toxicity Characteristic Leaching Procedure (TCLP) VOC;
- TCLP SVOC;
- TCLP metals;
- TCLP pesticides; and
- TCLP herbicides.

3.2.2.1 Field Observations

The soils encountered during excavation of the test pits generally consisted of two to three feet of brown sand and silt overlying approximately three to four feet of gray to black sand, silt and gravel. A light to medium gray clay and silt underlying the black soils was encountered at approximately five to six foot depths. The brown and black soils appeared to be fill materials, possibly placed during construction of the rail line. The gray clay and silt appeared to be a naturally existing formation.

Standing water was present within the drainage ditch on the day of the investigation. During excavation, black groundwater was observed entering the test pits at 3.5 foot to 5.0 foot depths. Moderate to strong pungent odors were noted emanating from the soil and water. Wooden planks and timbers were observed in the east sidewall of TP-1 and appeared to be shoring for a previous intent.

Air Monitoring

Air monitoring performed during excavation and sampling activities did not indicate the presence of hydrogen sulfide or ammonia. Carbon disulfide was detected within the excavations at up to 8.0 ppm, immediately above the excavations at up to 5.0 ppm, and in the breathing zone at TP-6 at 3.0 ppm. PID measurements within the test pits ranged from 0.0 ppm to 20 ppm, and in the breathing zone from 0.0 ppm to 4.0 ppm, with peaks of up to 20 ppm. When warranted by the breathing zone data, work ceased and any vapors present were permitted to diminish to acceptable concentrations before proceeding.

3.2.2.2 Analytical Results

The analytical results for the first water main investigation are presented as a range of concentrations and an average concentration for each identified contaminant of concern. The results are also discussed according to sample depths. Samples collected from the upper three feet of soil (i.e., the soil surrounding the water main) are discussed as a group, as are the samples collected from depths greater than three feet. All deeper samples were collected within the five foot to six foot depth interval. The complete analytical results for the first water main investigation are summarized in Table 1.

Volatile Organic Compounds

Carbon disulfide was detected in 11 of the 12 samples at concentrations ranging from an estimated 0.004 ppm to 2,500 ppm, with an average detected concentration of 500 ppm. Samples collected within the upper three feet of soil showed detected carbon disulfide concentrations of 0.004 ppm to 0.081 ppm, with an average of 0.036 ppm. Samples collected from the five foot to six foot depth interval showed concentrations of 20 ppm to 2,500 ppm, with an average of 918 ppm.

Semivolatile Organic Compounds

Benzo(k)fluoranthene was detected in five of the 12 samples at concentrations of 0.019 ppm to 0.44 ppm, with an average detected concentration of 0.17 ppm. Samples from the upper three feet of soil showed an average benzo(k)fluoranthene concentration of 0.070 ppm, and samples from the five foot to six foot depth interval showed an average concentration of 0.237 ppm.

Benzo(a)pyrene was detected in six of the 12 samples at concentrations of 0.006 ppm to 0.78 ppm, with an average of 0.21 ppm. Samples from the upper three feet of soil showed an average benzo(a)pyrene concentration of 0.006 ppm, and samples from five to six feet below grade showed an average concentration of 0.251 ppm.

Metals

Antimony was not detected in samples from the upper three feet of soil. The six samples collected within the five foot to six foot depth interval showed detected antimony concentrations of 1.3 ppm to 7.9 ppm, with an average detected concentration of 3.18 ppm.

Arsenic was detected in all 12 of the samples at concentrations of 3.9 ppm to 262 ppm, with an average of 58.2 ppm. Samples from the upper three feet of soil showed an average arsenic concentration of 8.72 ppm, and samples from the five foot to six foot depth interval showed an average concentration of 107.7 ppm.

Beryllium was detected in all 12 of the samples at concentrations of 0.09 ppm to 1.2 ppm, with an average of 0.37 ppm. Samples from the upper three feet of soil showed an average beryllium concentration of 0.22 ppm, and samples from the five to six foot depth interval showed an average of 0.53 ppm.

Copper was detected in all 12 soil samples at concentrations of 1.8 ppm to 753 ppm, with an average of 95 ppm. Samples from the upper three feet of soil showed an average copper concentration of 6.8 ppm. Samples from the five foot to six foot depth interval showed an average concentration of 183.2 ppm.

Manganese was detected in all 12 of the samples at concentrations of 5.2 ppm to 215 ppm, with an average of 64.9 ppm. Samples from the upper three feet of soil showed an average manganese concentration of 36.2 ppm, and samples from the five to six foot depth interval showed an average of 93.6 ppm.

3.2.3 Investigation of Water Main-Second Event

The second water main investigation consisted of the excavation and sampling of six test pits along a 1,250 foot length of the water main. The sampling plan for the second water main investigation and notification of field activities were provided to USEPA in Langan's memo of 14 September 1995 and letter of 29 November 1995. Test pits were excavated adjacent to and north and south of the drainage ditch. The investigation also included the exposure and examination of the water main in two test pit locations and physical testing of the soil and pipe at those two locations. The objective of the second investigation was to evaluate the presence, extent and degree of soil contamination (particularly carbon disulfide) surrounding the water main, evaluate the physical condition of the main, and evaluate the potential for stray currents or corrosive soils to adversely impact the main.

The six test pits, TP-28 through TP-33, were excavated and sampled on 11 and 13 December 1995. Excavation services were provided by Code Environmental Services, Inc. (Code) of Carteret, New Jersey utilizing a John Deere 310 D tire-mounted backhoe. Physical and electrical testing of the soil and water main was performed by a National Association of Corrosion Engineers (NACE) - certified specialist from RAM Services of Bellvale, New York. Site supervision and collection of environmental samples was performed by Langan personnel. All field operations were observed by a representative of CH_2M Hill, the USEPA oversight contractor, and by a representative of ERM. A United Water work crew was on standby to perform repairs in the event that the water main was damaged. All excavation activities performed adjacent to the rail line and in the Conrail right-of-way were observed by Mr. Denny

Weise, a Conrail Supervisor/Inspector. All excavation, sampling and testing activities completed during the second water main investigation were performed in modified Level D PPE.

The six test pits were excavated at 100 foot to 325 foot intervals along the length of the water main as proposed in the RAP. Test pits TP-28 and TP-29 were excavated north of the drainage ditch area, approximately 500 feet and 250 feet north of test pit location TP-1, respectively. Due to space limitations at the TP-28 and TP-29 locations, both test pits were excavated in the Conrail right-of-way, to the east of the water main. Test pits TP-30 and TP-31, excavated adjacent to the drainage ditch, were located west of the water main and approximately 100 feet apart. Test pits TP-32 and TP-33 were excavated south of the drainage ditch area and west of the water main, approximately 250 feet and 500 feet south of test pit location TP-6, respectively. The test pits were oriented parallel to the water main as proposed in the RAP, and were excavated to 2½ foot to 4½ foot widths, six foot to 9 ½ foot lengths, and a maximum depth of 8½ feet.

To evaluate the extent of soil contamination along the water main, a total of 14 soil samples were collected, two to three samples from each test pit. As proposed in the RAP, the samples were to be collected from each test pit as follows: one sample from a depth corresponding to the base of the water main (estimated at 2½ feet to 3½ feet below grade); one sample above the water main if contamination was suspected based on field observations; and one, if necessary, from the depth interval suspected to be most contaminated based on field observations.

The proposed sample locations were modified based on field conditions to more effectively delineate the vertical extent of contamination around the water main. Although no evidence of contamination was observed in soil above the water main, two samples (TP-30-104 and TP-31-100) were collected directly above the main to document soil conditions within the worker safety zone. As proposed in the RAP, samples were collected from each test pit at the base of the water main and at the depth interval suspected to be most contaminated. In test pits TP-29 through TP-33, these sample locations coincided. Samples were also collected from soil which appeared "cleaner" based on field observations. In test pits TP-28, TP-31, TP-32 and TP-33 samples of the "cleaner" soils were collected at depths of 5.0 feet to 8.5 feet below grade. Samples of the "cleaner" soils in the 5.0 foot to 8.5 foot depth interval were not collected from TP-29 or TP-30. USEPA was notified of the sample location modifications through Witco's 23 February 1996 progress report.

In addition to the soil sampling, one ground water sample was collected to evaluate ground water quality near the water main. The groundwater sample was collected from test pit TP-31, which was suspected to be contaminated based on field observations.

The soil and groundwater samples were submitted for laboratory analysis of the following parameters proposed in the RAP:

- CLP VOC;
- CLP SVOC;
- CLP Pesticides/PCBs;
- CLP Metals;
- CLP Cyanide;
- Thiocyanate; and
- Free Cyanide.

The soil samples were additionally analyzed for the following parameters proposed in the RAP:

- Ignitability;
- Corrosivity;
- Cyanide Reactivity;
- Sulfide Reactivity; and
- pH.

The RAP was modified to include soil sample analyses for Total Organic Carbon (TOC). USEPA was notified of the modification.

As proposed in the RAP, a composite sample for each test pit was to be prepared at the laboratory by compositing a portion of the samples from each excavation. The composite sample was to be analyzed for the parameters listed below. The RAP was modified so that only the grab soil samples collected from the depth interval suspected to be most contaminated in each test pit were analyzed for the parameters listed below. USEPA was notified of the modifications through Witco's progress report of 22 December 1995.

- TCLP VOC;
- TCLP SVOC;
- TCLP Metals;
- TCLP Pesticides; and
- TCLP Herbicides.

3.2.3.1 Field Observations

The soils encountered during the second water main investigation were similar to those encountered during the first investigation. Soils at the four northernmost test pit locations (TP-28 through TP-31) generally consisted of two to three feet of yellow-brown sand and silt overlying approximately two to four feet of dark gray to black sand, silt and gravel containing what appeared to be cinder and slag fragments. A six inch to nine inch thick layer of dark brown peat underlies the black soils in TP-30 and TP-31. A medium to dark gray clay and silt underlying the peat and black soils was encountered at 4¾ foot to 6 ½ foot depths. Soils encountered at the two southernmost test pit locations (TP-32 and TP-33) consisted of four to six feet of yellow-brown sand and silt overlying 1½ to 2½ feet of gray sand and silt. In test pit TP-32, the gray sand and silt formed alternating layers approximately six inches thick. A dark gray clay underlying the gray sand and silt was encountered at a 5½ foot depth in TP-33. The clay was not encountered in TP-32, which was excavated to a depth of 8½ feet.

In all of the test pits, the yellow-brown, gray and black sands and silts appeared to be fill materials. The brown peat and gray clayey soils appeared to be naturally occurring formations. Excavation of each test pit was terminated upon encountering the gray clay and silt. Unstable sidewalls limited excavation of TP-32 to a depth of 8½ feet, and the clay was not encountered.

During excavation of the four northernmost test pits, dark gray groundwater entered the excavations rapidly through the black sand, silt and gravel and rose to within 2½ to 3½ feet of the surface grade. During collection of the groundwater sample from TP-31, globules of oily black liquid, which appeared to be free product, were visible in the water. Groundwater in TP-29 and TP-31 also exhibited a slight sheen. In the southernmost test pits, TP-32 and TP-33, groundwater seepage was observed at 8½ foot and 5 foot depths, respectively, and did not appear to be discolored. No large debris was encountered in any of the test pits except for a wooden plank observed along the west sidewall of TP-30 at a three foot depth. The plank appeared to be shoring for a previous purpose.

Air Monitoring

Air monitoring performed during excavation and sampling of the test pits did not indicate the presence of carbon disulfide, hydrogen sulfide or volatile organic vapors within the sampling team's breathing zone. Within the test pits, hydrogen sulfide and volatile organic vapors were not detected. Carbon disulfide was detected only in TP-31, at a concentration of 1 ppm. Moderate to strong pungent odors were noted during excavation of TP-30 and TP-31, the test pits adjacent to the drainage ditch. At no time did air monitoring data or physical observations warrant a cessation of work activities or an upgrade of PPE from Level D.

3.2.3.2 Water Main Inspection and Corrosion Testing

Following excavation and backfilling of TP-30 and TP-31, six to eight foot lengths of the water main adjacent to those locations were carefully excavated by hand. The water main was completely exposed at the two locations, removing soil above, below and from the sides of the pipe.

Examination of the exterior of the main revealed that the main is constructed of 16-inch diameter iron piping tightly wrapped in several layers of approximately 20 mil thick clear plastic sheeting. The plastic sheeting appeared to be in good condition, with no deterioration or holes observed. At the TP-30 location, a six-inch wide section of plastic was cut and removed completely around the main to permit visual inspection and testing of the pipe. A small section of plastic was removed from the top of the pipe at the TP-31 location for inspection of the pipe. Visual examination of the pipe by RAM Services revealed no significant corrosion of the outer surface.

Testing of the pipe and surrounding soils was performed by RAM Services with the assistance of Langan and Code personnel. The testing included soil resistivity, stray current and structure-to-soil electric potential analyses to evaluate the potential for corrosion of the pipe. Ultrasonic pipe wall thickness and electrical continuity testing were also performed to evaluate the physical condition of the pipe. Upon completion of testing activities, the exposed pipe sections were tightly rewrapped using new 20 mil thick plastic sheeting secured with duct tape, and the excavations were backfilled using the previously excavated soil.

A report documenting the water main corrosion testing was prepared by RAM Services and is included in this report as Appendix C. The RAM Services report discusses the testing procedures and results and provides recommendations with respect to corrosion protection of the water main.

According to the RAM Services report, soil resistivity at the TP-30 and TP-31 locations was measured to be 25,000 ohm-centimeters (ohm-cm) and 35,000 ohm-cm, respectively. Both of the measurements identify the soils at those locations as "less corrosive". Structure-to-soil potential measurements of -0.445 volts and -0.490 volts were recorded at the TP-30 and TP-31 locations, respectively. Both of these measurements are generally acceptable, falling within the "normal" corroding potential range. The stray current analysis was performed by monitoring the structure-to-soil measurements for a period of 10 minutes. No fluctuations in the measurements were observed, indicating that effects from stray currents were not present. Pipe wall thickness measurements ranging from 670 to 800 mils were recorded at the two locations, with an average value of 731 mil, or approximately ¾ inch. Electrical continuity measurements between the two exposed pipe sections exceeded one million ohms. It is suspected that the water main is of "bell and spigot" type construction, and the continuity measurement indicates that rubber gaskets may have been used to join the pipe sections. It does not appear that an attempt was made to make the water main electrically continuous.

According to the RAM Services interpretation of the results of the water main inspection and testing, the main does not appear to be located in an overly corrosive environment in the areas tested. RAM Services concluded that all testing and inspection results indicate that the water main appears to be in good to excellent condition. RAM Services recommended considering the installation of sacrificial anodes to cathodically protect the water main from potential corrosion and prolong its useful life. The water main is approximately 30 years old.

3.2.3.3 Analytical Results

The analytical results for the second water main investigation are presented in this section typically as a range of concentrations and an average concentration for each identified contaminant of concern. The results are also discussed according to sample depths. Samples collected from the upper four feet of soil (i.e., the soil surrounding the water main) are discussed as a group; as are samples collected from depths greater than four feet. All samples collected below a four foot depth were collected within the 5.0 foot to 8.5 foot depth interval. The complete analytical results for the second water main investigation are summarized in Table 2 (soil results) and Table 3 (groundwater results).

Volatile Organic Compounds

Carbon disulfide was detected in three of the 14 soil samples. Sample TP-30-104, which was collected directly above the water main, contained carbon disulfide at an estimated concentration of 0.095 ppm. Samples TP-31-101 (collected from 3.0 feet to 3.5 feet below grade) and TP-31-103 (5.5 feet to 6.0 feet) contained carbon disulfide at concentrations of 5,300 ppm and 3,900 ppm, respectively.

Carbon disulfide was detected in groundwater sample TP-31-102 at a concentration of 1,500,000 parts per billion (ppb).

Semivolatile Organic Compounds

Benzo(k) fluoranthene was detected in eight of the 14 soil samples at estimated concentrations of 0.005 ppm to 0.1 ppm, with an average detected concentration of 0.032 ppm. Samples collected from the upper four feet of soil showed an average detected concentration of 0.027 ppm, and samples collected within the 5.0 foot to 8.5 foot depth interval showed an average detected concentration of 0.04 ppm. Samples TP-30-104 and TP-31-100, collected directly above the water main, showed benzo(k) fluoranthene concentrations of 0.005 ppm and "Not Detected", respectively.

Benzo(a) pyrene was detected in eight of the 14 soil samples at estimated concentrations of 0.008 ppm to 0.16 ppm, with an average detected concentration of 0.049 ppm. Samples collected from the upper four feet of soil showed an average detected concentration of 0.039 ppm, and samples collected within the 5.0 foot to 8.5 foot depth interval showed an average detected concentration of 0.065 ppm. Samples TP-30-104 and TP-31-100, collected directly above the water main, showed benzo(a) pyrene concentrations of 0.008 ppm and "Not Detected", respectively.

Groundwater sample TP-31-102 did not contain detectable concentrations of benzo(k) fluoranthene or benzo(a) pyrene.

Metals

Antimony was detected in two of the 14 soil samples. Samples TP-29-070 (collected from 3.0 feet to 3.5 feet below grade) and TP-31-101 (3.0 feet to 3.5 feet) showed antimony at concentrations of 13.3 ppm and 17.6 ppm, respectively.

Arsenic was detected in all 14 of the soil samples at concentrations of 2.4 ppm to 1,560 ppm, with an average of 133.3 ppm. Excluding the highest arsenic concentration (1,560 ppm) would result in a typical concentration range of 2.4 ppm to 92.9 ppm and a typical average concentration of 21.9 ppm. Samples from the upper four feet of soil showed a typical average concentration of

17.7 ppm, and samples from the 5.0 foot to 8.5 foot depth interval showed an average of 33.0 ppm. The highest arsenic concentration, 1,560 ppm, was detected in sample TP-31-101 collected from 3.0 to 3.5 feet below grade. Samples TP-30-104 and TP-31-100, collected directly above the water main, showed arsenic concentrations of 3.1 ppm and 4.1 ppm, respectively.

Beryllium was detected in all 14 of the soil samples at concentrations of 0.1 ppm to 0.96 ppm, with an average of 0.38 ppm. Samples collected from the upper four feet of soil showed an average concentration of 0.30 ppm, and samples collected within the 5.0 foot to 8.5 foot depth interval showed an average concentration of 0.54 ppm. Samples TP-30-104 and TP-31-100, collected directly above the water main, showed beryllium concentrations of 0.2 ppm and 0.1 ppm respectively.

Copper was detected in all 14 soil samples at concentrations of 1.8 ppm to 4,640 ppm, with an average of 565.9 ppm. Excluding the highest copper concentration (4,640 ppm) would result in a typical concentration range of 1.8 ppm to 2,200 ppm, with a typical average concentration of 252.5 ppm. Samples from the upper four feet of soil showed a typical average concentration of 63.1 ppm, and samples from the 5.0 foot to 8.5 foot depth interval showed an average of 555.7 ppm. The highest copper concentration, 4,640 ppm, was detected in sample TP-31-101 collected from 3.0 to 3.5 feet below grade. Samples TP-30-104 and TP-31-100, collected directly above the water main, showed copper concentrations of 7.7 ppm and 5.5 ppm, respectively.

Manganese was detected in all 14 of the soil samples at concentrations of 12.1 ppm to 360 ppm, with an average concentration of 107.8 ppm. Samples collected from the upper four feet of soil showed an average manganese concentration of 103.2 ppm, and samples collected within the 5.0 foot to 8.5 foot depth interval showed an average concentration of 116.1 ppm. Samples TP-30-104 and TP-31-100, collected directly above the water main, showed manganese concentrations of 44.8 ppm and 12.5 ppm, respectively.

Groundwater sample TP-31-102 contained: antimony, arsenic, beryllium and manganese at concentrations of 11.9 ppb, 3,840 ppb, 1.0 ppb and 2,910 ppb, respectively.

3.2.4 Drainage Ditch Delineation

The drainage ditch delineation consisted of the excavation and sampling of 16 test pits located west of the former drainage ditch. The purpose of the delineation was to evaluate the vertical and horizontal extent of soil contamination within the ditch.

The 16 test pits, TP-7, TP-8, TP-11, TP-12, TP-13, TP-18, TP-21, TP-23 and TP-34 through TP-41, were excavated and sampled in December 1995 and January 1996. Test pits TP-7 through TP-23 were excavated and sampled between 12 December 1995 and 18 December 1995. Test pits TP-34, TP-35 and TP-36 were excavated on 28 December 1995. Test pits TP-37 through TP-41 were excavated on 29 and 30 January 1996. Excavation services were provided by Code using a John Deere 310D tire-mounted backhoe for test pits TP-7 through TP-36, and a John Deere 690 ELC track-mounted backhoe was used for test pits TP-37 through TP-41. Site supervision and sample collection duties were performed by Langan personnel, and field operations were observed by representatives of CH_2M Hill and ERM. The ERM personnel also performed field screening of soil samples for carbon disulfide using portable gas chromatography (GC) instrumentation. Representatives of USEPA and DNREC were present on 12 December 1995 to observe site activities.

As proposed in the RAP, the drainage ditch delineation was to include the excavation and sampling of 17 test pits within the ditch and the area bounded by the site security fence. The RAP was modified with respect to the number of test pits and their locations because of soil flashing observed in test pits TP-18, TP-21 and TP-23 (located adjacent to the drainage ditch). Nine of the proposed test pits (TP-9, TP-10, TP-14, TP-15, TP-16, TP-17, TP-19, TP-20 and TP-22) located in and adjacent to the ditch were not excavated. Based on the observed soil flashing and the high concentrations of carbon disulfide previously identified in the ditch by USEPA, Witco believes that the need for additional data did not warrant the greater safety risks associated with sampling those locations. Because additional data was not obtained by sampling within the ditch, evaluation of soil contamination in the ditch will be based on the results of previous sampling performed by USEPA. Notification of the proposed changes to the RAP was provided to USEPA in the Langan/USEPA telephone conversation of 27 December 1995, and in Langan's letters of 10 and 25 January 1996.

Based upon field observations from TP-18, TP-21 and TP-23, and to further delineate the horizontal extent of contamination, eight test pits not formerly proposed in the RAP were excavated and sampled. The additional test pits were located along the west edge of the area bounded by the site security fence (TP-34, TP-35 and TP-36) and north and west of the fenced area (TP-37 through TP-41). To minimize risks to sampling personnel, an extended reach backhoe equipped with a 50 foot long excavator arm was used to excavate test pits TP-37 through TP-41.

Of the 16 test pits excavated during the drainage ditch delineation, 11 were located within the area bounded by the site security fence and five were located north and west of the fenced area. The test pits within the security fence (TP-7, TP-8, TP-11, TP-12, TP-13, TP-18, TP-21, TP-23, TP-34, TP-35 and TP-36) were located west of the drainage ditch and were excavated to lengths of seven to 13 feet, widths of 2½ to five feet and depths of six to 12 feet. The test pits north and west of the fenced area (TP-37 through TP-41) were excavated to lengths of 10 to 15 feet, widths of 4½ to 5½ feet and depths of nine to 14 feet.

As proposed in the RAP for the drainage ditch area test pits, one sample was to be collected within two feet above the water table and one sample from the depth interval suspected to be most contaminated. If the two specified sample locations coincided, one sample was to be collected.

During excavation of these test pits a total of 30 soil samples were collected, with two samples collected from each test pit except for test pits TP-23 and TP-36. The RAP was field modified with respect to specified sample depths to more effectively delineate the vertical extent of contamination in each test pit. Modification of the RAP consisted of the collection of one sample from the depth interval suspected to be most contaminated (typically within the three foot to eight foot depth interval), and one sample was collected at a greater depth from apparently "cleaner" soil (typically within the six foot to 12 foot depth interval). The distinction between contaminated and "cleaner" soils was based on field measurements and observations including color, odor, PID readings and soil constituents such as fill materials. Only one sample was collected from test pits TP-23 and TP-36 in order to minimize potential fire hazards at those locations. Soil flashing was observed in TP-23, and air monitoring data indicated the potential for soil flashing in TP-36. Soil samples collected from the drainage ditch area test pits were analyzed (as proposed in the RAP) for the same parameters as samples collected during the second water main investigation discussed in Section 3.2.3.

3.2.4.1 Field Observations

The soils encountered in the drainage ditch area test pits generally consisted of a layer of fill material overlying what appeared to be natural silt, clay and sand formations. The fill materials, consisting of sand, gravel, cinders, slag, construction debris and automobile tires, were found to depths of one to three feet in the southern half of the area and to depths of four to seven feet in the northern half. The greatest concentrations of debris were encountered in the northern half of the ditch area, where several test pits contained large amounts of wood, construction debris or tires. Underlying the fill material was a layer of medium gray to black silt and/or clay. The silt/clay layer was typically two to five feet thick in the southern half of the drainage ditch area and three to six feet thick in the northern half. The upper one to two feet of this layer typically contained roots and other plant debris, and a six inch to eight inch thick layer of peat or matted plant debris was encountered in several test pits. Occasional thin red-brown, purple or yellow-green sand layers were noted in the silt and clay, and occasional 1/16 inch yellow-green crystals were observed in the silt in TP-21. The silt/clay layer was interpreted as the Recent Sediment formation. Underlying the silt/clay layer was a yellow-brown to light gray sand, silt and clay formation. The yellow-brown and light gray soils were encountered at depths of five to 13 feet and were interpreted as Columbia Formation soils.

Groundwater was encountered in the test pits at depths of two feet to 12 feet below grade, but it typically occurred at depths of three feet to five feet. In test pits with significant quantities of debris, such as wood or tires, groundwater entered rapidly through the debris and filled the excavation. In test pits containing little or no debris or porous fill, groundwater typically entered the excavations as seeps along the silt/clay layer. In several test pits, groundwater entered rapidly after excavating through the silt/clay layer and into the underlying sandy soil. The groundwater was typically gray in color, although in several test pits (TP-18, TP-21, TP-36, and TP-39) it was black and exhibited a slight sheen and a strong pungent odor.

Air Monitoring

During excavation, moderate to strong pungent odors were noted emanating from the test pits and excavated soils. Air monitoring of the breathing zone did not reveal the presence of carbon disulfide, hydrogen sulfide or ammonia vapors. Volatile organic vapors were detected in the breathing zone only at test pit locations TP-21 and TP-23. Peak concentrations of 5.0 ppm to 60 ppm were detected at TP-21, and sustained concentrations of 5.0 ppm to 8.0 ppm were detected at TP-23. During the backfilling of TP-18 and TP-21, the backhoe operator reported soil flashing around the excavated soil. Soil flashing was observed again in test pit TP-23, where volatile vapors within the test pit and over the excavated soil ignited momentarily during excavation resulting in a soil flash approximately 12 feet in diameter. Most of the drainage ditch area test pits were sampled in Level C PPE. Based on the reported soil flashing in TP-18 and TP-21, health and safety measures were upgraded to Level B PPE for test pit TP-23.

Field GC Results

Samples were collected by Langan sampling personnel for field GC analysis from test pits TP-7 through TP-36 (except for TP-12) and screened for carbon disulfide by ERM personnel. The field GC instrumentation was not available during the sampling of test pits TP-37 through TP-41. Samples were collected at two foot intervals when possible, but at several locations large amounts of debris prevented collection of an adequate sample. The greatest concentrations of carbon disulfide were typically found in samples collected between six foot and ten foot depths, with screening results typically ranging from approximately 5 ppm to 1,000 ppm. The highest concentration found with the field GC was approximately 13,000 ppm, found in TP-21 at a depth of 12 feet. A summary of all field GC data obtained during the RAP implementation is included in Table 4.

3.2.4.2 Analytical Results

The analytical results for the drainage ditch area investigation are presented as a range of detected concentrations and an average detected concentration for each contaminant of concern identified by USEPA. The results are also discussed according to sample locations. The samples collected from the depth intervals suspected to be most contaminated (i.e., from the fill materials and the upper portion of the silt/clay layer) are discussed as a group, as are samples collected from deeper soils thought to be less contaminated ("cleaner") based on field observations. Samples of soil suspected to be contaminated were typically collected within the 3.0 foot to 7.0 foot depth interval. Samples of "cleaner" soil were typically collected from depths of 5.0 feet to 12.0 feet. A summary of the complete analytical results for the drainage ditch area samples is included in Table 5.

Volatile Organic Compounds

Carbon disulfide was detected in 24 of the 30 soil samples at concentrations ranging from an estimated 0.054 ppm to 28,000 ppm, with an average of 4,602 ppm. Carbon disulfide was not detected in test pits TP-39, TP-40 or TP-41. Samples collected from soil suspected to be most contaminated showed detected carbon disulfide concentrations of 0.054 ppm to 28,000 ppm, with an average of 6,768 ppm. Samples collected from suspected "cleaner" soils showed concentrations of 2.0 ppm to 16,000 ppm, with an average concentration of 2,043 ppm.

Semivolatile Organic Compounds

Benzo(k)fluoranthene was detected in seven of the 30 samples at estimated concentrations of 0.004 ppm to 3.1 ppm, with an average of 0.566 ppm. Samples from the soil suspected to be most contaminated showed estimated benzo(k)fluoranthene concentrations of 0.004 ppm to 3.1 ppm, with an average of 0.627 ppm. Benzo(k)fluoranthene was detected in the suspected "cleaner" soil samples only in test pit TP-7, at an estimated concentration of 0.2 ppm.

Benzo(a)pyrene was detected in eight of the 30 samples at concentrations ranging from an estimated 0.009 ppm to 9 ppm, with an average of 1.36 ppm. Samples from suspected contaminated soil showed benzo(a)pyrene concentrations of 0.009 ppm to 9.0 ppm, with an average of 1.51 ppm. Benzo(a) pyrene was detected in the suspected "cleaner" soils only in test pit TP-7, at an estimated concentration of 0.32 ppm.

Metals

Antimony was detected in four of the 30 samples at estimated concentrations ranging from 1.2 ppm to 7.9 ppm, with an average of 3.98 ppm. Sample TP-12-088, TP-34-136 and TP-38-160, collected from suspected contaminated soil, contained antimony in concentrations of 3.5 ppm, 7.9 ppm and 3.3 ppm, respectively. Sample TP-41-150, collected from suspected "cleaner" soils, contained 1.2 ppm of antimony.

Arsenic was detected in all of the samples at concentrations of 2.3 ppm to 11,900 ppm, with an average of 970 ppm. Samples collected from suspected contaminated soil showed arsenic concentrations of 2.9 ppm to 11,900 ppm, with an average of 1,785 ppm. Samples of suspected "cleaner" soils showed arsenic concentrations of 2.3 ppm to 303 ppm, with an average of 38.2 ppm.

Beryllium was detected in 29 of the 30 samples at concentrations ranging from an estimated 0.16 ppm to 3.7 ppm, with an average of 0.78 ppm. Samples of suspected contaminated soil showed beryllium concentrations of 0.16 ppm to 3.7 ppm, with an average of 1.08 ppm. Samples of suspected "cleaner" soils showed concentrations of 0.19 ppm to 0.62 ppm, with an average of 0.45 ppm.

Copper was detected in all 30 samples at concentrations of 6.8 ppm to 13,100 ppm, with an average of 878.1 ppm. Samples collected from the suspected contaminated soil showed copper concentrations of 7.8 ppm to 13,100 ppm, with an average of 1,557.7 ppm. Samples of suspected "cleaner" soils showed copper concentrations of 6.8 ppm to 1,250 ppm, with an average of 101.5 ppm.

Manganese was detected in all 30 of the samples at concentrations of 46.5 ppm to 9,030 ppm, with an average of 585 ppm. Samples of suspected contaminated soils showed manganese concentrations of 55.7 ppm to 9,030 ppm, with an average of 1,005 ppm. Samples of suspected "cleaner" soils showed concentrations of 46.5 ppm to 262 ppm, with an average of 106 ppm.

3.2.5 Sump Area Delineation

The sump area delineation consisted of the excavation and sampling of four test pits around the former sump location at the northeast corner of the process plant area. The objective of the delineation was to evaluate the presence, extent and degree of soil contamination, particularly carbon disulfide, around the former sump location.

The four test pits, TP-24 through TP-27, were excavated and sampled on 11, 12 and 14 December 1995. Excavation services were provided by Code utilizing a rubber tire-mounted backhoe. Site supervision and collection of environmental samples was performed by Langan. The excavation and sampling activities were observed by representatives of CH_2M Hill and by ERM. The ERM personnel also performed field screening of soil samples from TP-26 using portable GC instrumentation. The field screening was performed at two foot depth intervals. The field GC instrumentation was not available to screen samples from the other sump area test pits. All excavation and sampling activities completed during the sump area delineation were performed in modified Level D or Level C PPE. Representatives of USEPA and DNREC were present on 12 December 1995 to observe the site activities.

The four test pits were excavated within 25 feet of sample locations previously identified by USEPA as having carbon disulfide concentrations exceeding 10 ppm. Test pits TP-24 and TP-27 were excavated approximately 50 feet east and 50 feet south of the former sump location, respectively. Test pits TP-25 and TP-26 were excavated approximately 35 feet and 70 feet west of the former sump, respectively. The tests pits were excavated to approximately three foot widths, six to nine foot lengths, and a maximum depth of six feet. As proposed in the RAP, the test pits were to be oriented parallel to the water main. Because of accessibility restrictions, test pits TP-24 and TP-27 were excavated at an angle to the water main, and test pit TP-26 was excavated perpendicular to it. USEPA was notified of the modified test pit orientation through Witco's progress report of 23 February 1996.

The RAP specified that when sampling each sump area test pit, one sample was to be collected within two feet above the water table and one sample from the depth interval suspected to be most contaminated. If the two specified sample locations coincided, one sample was to be collected.

During implementation of the RAP, a total of eight soil samples were collected, two samples from each test pit. One sample was collected from within two feet above the water table, which was estimated to be 3 to 3½ feet below the surface grade. The sample locations above the water table coincided with depth intervals suspected to be most contaminated, satisfying the RAP-specified sampling protocols. Because the RAP specified sampling protocols were satisfied by the collection of one sample, the RAP was field-modified to further delineate the vertical extent of contamination in each test pit. Modification of the RAP consisted of collection of a second sample from each test pit at a greater depth than the first. The test pits were excavated until apparently "cleaner" soils were encountered based on field measurements and observations. A second sample was collected below the water table in each test pit from the "cleaner" soils within the 4.0 foot to 5.0 foot depth interval. USEPA was notified of the modified sampling locations through Witco's progress report of 23 February 1996. The soil samples collected from the sump area were analyzed (as proposed in RAP) for the same parameters as samples collected during the second water main investigation described in Section 3.2.3.

3.2.5.1 Field Observations

The soils encountered during excavation in the sump area generally consisted of three to four feet of fill materials overlying what appeared to be a natural silt and clay formation. Of the four sump area test pits, three (TP-25, TP-26 and TP-27) were excavated within the process plant area, and one (TP-24) was excavated outside of the process plant area. The specific soil types encountered in each test pit varied with location.

The sump located within the process plant area was the object of a USEPA removal action in 1995. Contaminated soil was excavated and stockpiled on-site, and the excavation was backfilled with clean soil. The precise limits of the excavation are unknown, but it is estimated that 160 cubic yards of soil were excavated and stockpiled.

Test pit TP-24, located east of the former sump, revealed a soil stratigraphy similar to the test pits excavated during the water main investigations. The soils in TP-24 consisted of 2½ feet of brown to yellow-brown sand and silt overlying 1½ feet of black sand, silt and gravel. A medium gray clay was encountered at a depth of four feet. Both the yellow-brown and black soil layers appeared to be fill materials, with the black soils containing broken glass, wood and cinders. The gray clay appeared to be naturally occurring.

Test pit TP-25 appeared to have been located on the northwest edge of the area excavated during the EPA removal action. Soils encountered in the northern half of the test pit consisted of one foot of gray sand and silt overlying approximately three feet of gray to black silt and clay. A large quantity of broken glass was recovered from the black silt at approximately three feet below grade. A medium gray silt, sand and clay containing reeds and other organic debris was encountered at a four foot depth. In the southern half of the test pit, approximately one to five feet of yellow-brown sand was encountered overlying the silt. According to a USEPA representative present during excavation of TP-25, the yellow-brown sand encountered in the southern half of the test pit is clean fill placed during the USEPA removal action.

The soils encountered in test pit TP-26 consisted of two feet of gray-brown silty sand and gravel overlying ¾ foot of black sand and silt. A medium gray silty clay was encountered at a depth of approximately three feet. The gray-brown and black sands appeared to be fill materials and contained debris including wood, bricks, wire, rubber and glass. The gray-brown silty clay contained plant roots and organic debris and appeared to be naturally occurring.

The soils encountered in test pit TP-27 consisted of two feet of dark gray to black sand and gravel overlying dark gray silt, clay and sand. The upper two feet of sand and gravel appeared to be fill materials, and a layer of debris consisting of bricks and wood was encountered at a depth of approximately two feet. The dark gray silt, clay and sand formation contained a significant amount of plant roots and may be naturally occurring.

During excavation of the sump area test pits, groundwater seepage was observed generally at 3 to 3½ foot depths. The groundwater seeps appeared to occur just above the clayey soils present near the bottoms of each test pit. Seepage into the test pits was generally slow, with the greatest flow occurring in TP-25. Groundwater seeping into TP-25 collected to a depth of about four inches on the bottom of the pit and exhibited a sheen.

Air Monitoring

Air monitoring performed during excavation and sampling of the test pits did not indicate the presence of carbon disulfide, hydrogen sulfide or volatile organic vapors within the breathing zone. Within the test pits, carbon disulfide and volatile organic vapors were not detected. Moderate to strong pungent odors were noted during excavation and sampling, but at no time did air monitoring data warrant a cessation of work activities or an upgrade of PPE from Level D. Sampling personnel did, however, employ respirators at their discretion to mitigate odors emanating from test pit TP-26.

Field GC Results

Samples were collected for field GC analysis from test pit TP-26 at two foot and four foot depths. According to ERM, the field GC screening for carbon disulfide revealed concentrations of 11 ppm at two feet, and not detected at four feet. Field GC samples were not collected from the other sump area test pits because ERM's GC instrumentation was not available for use.

3.2.5.2 Analytical Results

The sample analytical results for the sump area investigation are presented in this section typically as a range of concentrations and an average concentration for each contaminant of concern. The results are also discussed according to sample depths. Samples collected from the upper 3.5 feet of soil (the soil suspected to be most contaminated based on field measurements) are discussed as a group, as are the samples collected below a 3.5 foot depth from soils which appeared to be "cleaner". All samples collected below 3.5 feet were collected from the 4.0 foot to 5.0 foot depth interval. The complete analytical results for the sump area samples are summarized in Table 6.

<u>Volatile Organic Compounds</u>

Carbon disulfide was detected in four of the eight samples at estimated concentrations of 0.12 ppm to 0.36 ppm. Samples collected from the upper 3.5 feet of soil in TP-24 and TP-26 showed estimated concentrations of 0.36 ppm and 0.12 ppm, respectively. Samples collected within the 4.0 foot to 5.0 foot depth interval in TP-24 and TP-26 showed estimated concentrations of 0.18 ppm and 0.13 ppm, respectively. Carbon disulfide was not detected in samples from test pits TP-25 or TP-27.

<u>Semivolatile Organic Compounds</u>

Benzo(k) fluoranthene was detected in five of the eight samples at estimated concentrations of 0.012 ppm to 0.17 ppm, with an average of 0.063 ppm. Samples collected from the upper 3.5 feet of soil showed an average concentration of 0.10 ppm, and samples collected within the 4.0 foot to 5.0 foot depth interval showed an average concentration of 0.014 ppm. Benzo(k) fluoranthene was not detected in samples from test pit TP-25.

Benzo(a) pyrene was detected in five of the eight samples at estimated concentrations of 0.023 ppm to 0.39 ppm, with an average of 0.128 ppm. Samples collected from the upper 3.5 feet of soil showed an average detected concentration of 0.197 ppm, and samples collected from the 4.0 foot to 5.0 foot interval showed an average detected concentration of 0.023 ppm. Benzo(a) pyrene was not detected in samples collected from TP-25.

<u>Metals</u>

Antimony was detected in one of the eight samples, TP-24-072 (collected from 2.6 feet to 3.1 feet below grade), at a concentration of 9.8 ppm.

Arsenic was detected in all eight soil samples at concentrations of 4.5 ppm to 1,430 ppm, with an average concentration of 270.2 ppm. Samples collected from the upper 3.5 feet of soil showed an average concentration of 524.6 ppm, and samples collected from the 4.0 foot to 5.0 foot depth interval showed an average concentration of 15.8 ppm.

Beryllium was detected in all eight samples at concentrations of 0.19 ppm to 0.83 ppm, with an average concentration of 0.47 ppm. Samples collected from the upper 3.5 feet of soil showed an average concentration of 0.37 ppm, and samples collected within the 4.0 foot to 5.0 foot depth interval showed an average of 0.56 ppm.

Copper was detected in all eight soil samples at concentrations of 14.1 ppm to 6,710 ppm, with an average of 1,657.7 ppm. Samples collected from the upper 3.5 feet of soil showed an average concentration of 3,198.7 ppm. Samples collected from the 4.0 foot to 5.0 foot depth interval showed an average concentration of 116.7 ppm.

Manganese was detected in all eight samples at concentrations of 79.1 ppm to 559 ppm, with an average concentration of 215.7 ppm. Samples collected from the upper 3.5 feet of soil showed an average concentration of 309 ppm, and samples collected within the 4.0 foot to 5.0 foot depth interval showed an average concentration of 122.3 ppm.

3.2.6 Process Plant Area Borings

A soil boring investigation, not previously proposed in the RAP, was performed in the process plant area on 31 January 1996 as part of the RAP implementation. The borings were performed to further delineate the extent of arsenic contamination, provide leachability data for use in Witco's risk assessment, and provide information to evaluate the cost of excavation and disposal of the contaminated soil. The soil boring data supplements shallow soil sampling data previously obtained in the process plant area. Notification of the soil boring investigation and a description of the proposed sampling procedures was provided to USEPA and DNREC in Langan's letter of 25 January 1996. The investigation consisted of the completion and sampling of 10 soil borings to depths of 10 feet to 11 feet throughout the process plant area.

The soil boring activities were performed by Advanced Drilling, Inc. of New Holland, Pennsylvania using a Strata Star 15 drilling rig, hollow stem augers, and consecutively advanced two-inch and three-inch diameter steel split spoons. All drilling activities were supervised by a Langan field engineer, and air monitoring for health and safety purposes was performed by a Langan field engineer or geologist. All drilling and sampling activities were performed in Level D PPE. Witco contractor oversight was provided by a representative of ERM. Although USEPA and DNREC were notified that the soil boring investigation would proceed on 31 January 1996, neither USEPA nor DNREC representatives appeared at the site to observe the investigation.

The boring locations (LB-1 through LB-10) were selected based on surface soil arsenic concentrations identified in Langan's April 1993 Soil Grid Survey Investigation at the Halby site. The borings were located to both correspond to previous sample locations showing high arsenic concentrations and to provide sufficient coverage of the process plant area to adequately delineate the arsenic contamination. Borings LB-1 and LB-7 were field-relocated approximately 10 feet southwest and 18 feet north, respectively, of their proposed locations at the request of ERM to provide better delineation of the arsenic. USEPA was notified of the boring relocations through Witco's progress report of 9 February 1996.

The soil borings were sampled continuously from the surface to completion depths when possible. Samples were not collected from the upper two feet of LB-2 and LB-5 due to the presence of concrete debris at those locations. Samples for laboratory analysis were collected at two foot intervals in accordance with the sampling and quality assurance procedures presented in the FSP. The samples were analyzed by Envirotech for total arsenic, soluble arsenic and TCLP arsenic.

3.2.6.1 Field Observations

The soil boring investigation was performed on 31 January 1996. Air monitoring of the breathing zone during drilling and sampling did not indicate the presence of carbon disulfide or other volatile organic vapors, and Level D PPE was deemed sufficient for all drilling activities.

The soils encountered during the investigation generally consisted of up to seven feet of gray-brown to orange-brown sand, silt, gravel and clay overlying approximately three feet to eight feet of dark gray to black sand and silt. The black sand and silt appeared to possibly be ash or powdered coal, and was encountered in all borings except LB-10, in the extreme southern corner of the site. The medium gray to black silt and clay layers encountered in the drainage ditch area and sump area test pits were not encountered in any of the borings. The type of fill and debris encountered in the drainage ditch area was also not encountered in the borings. As previously noted, the upper two feet of LB-2 and LB-5 consisted of concrete debris.

<u>Air Monitoring</u>

Within the gray-brown to orange-brown soils, slight odors were occasionally noted, and PID readings typically ranged from zero to two ppm. The gray to black sand and silt typically exhibited slight to strong pungent odors and PID readings of zero to two ppm, with a peak of 17 ppm in LB-8.

3.2.6.2 Analytical Results

The analytical results for the soil boring investigation are presented below as a range of detected concentrations and an average detected concentration for each parameter. The results are also discussed according to sample depth intervals, and any atypical results are noted. A summary of the complete soil boring investigation results is included in Table 7. Arsenic results obtained during the RAP investigations within the process plant area are shown on Figure 10.

Total Arsenic

Total arsenic was detected in all 48 of the samples at concentrations of 1.2 ppm to 795 ppm, with an average of 93 ppm. Samples collected from the gray-brown to orange-brown soils (i.e. within the top seven feet of soil) showed total arsenic concentrations of 1.4 ppm to 795 ppm, with an average of 145 ppm. Samples collected from the underlying dark gray to black sand and silt showed concentrations of 1.8 ppm to 665 ppm, with an average of 77 ppm. Samples collected form LB-10, which appeared to be located in natural soils, showed total arsenic concentrations of 1.2 ppm to 5.1 ppm, with an average of 2.86 ppm.

It should be noted that samples collected from the upper two feet of soil exhibited an average total arsenic concentration of 242 ppm, while samples collected below a two foot depth showed an average concentration of 63 ppm. Samples collected below a depth of approximately five feet typically exhibited total arsenic concentrations of less than 35 ppm. However, in borings LB-6 and LB-9 total arsenic concentrations of 113 ppm to 665 ppm were detected at depths of seven to ten feet.

Soluble Arsenic

Soluble arsenic was detected in 22 of the 48 samples at concentrations of 0.09 ppm to 81.7 ppm, with an average of 6.96 ppm.

TCLP Arsenic

Of the 48 soil samples, three exhibited detectable concentrations of TCLP arsenic. Samples LB-6-194 (collected from 1.5 feet to 2.0 feet below grade), LB-6-197 (7.5 feet to 8 feet) and LB-9-214 (7.5 feet to 8.0 feet) showed TCLP arsenic concentrations of 0.49 ppm, 1.5 ppm and 0.61 ppm, respectively.

3.2.7 Additional Analytical Results

Additional laboratory analyses performed during the RAP implementation included air sample analyses, volatile organic static headspace analyses, and quality assurance analyses including, but not limited to, duplicate soil samples, equipment rinsate blanks, field blanks and trip blanks.

3.2.7.1 Air Sampling Results

A total of eight air samples (AS-1 through AS-5, AS-7, AS-8 and AS-9) were collected during implementation of the RAP. Five of the samples (AS-1, AS-2, AS-3, AS-7 and AS-9) were analyzed for arsenic, total chromium and lead. Three samples (AS-4, AS-5 and AS-8) were analyzed for hexavalent chromium. Trip blanks were included with each shipment of samples to the laboratory and were analyzed for the same parameters as the samples.

Arsenic, lead and hexavalent chromium were not detected on any of the sample filters. Total chromium was detected in the five samples in which it was analyzed at concentrations of 0.23 micrograms per filter (ug/filter) to 0.5 ug/filter. Taking into account pumping times and flow rates, total chromium concentrations in the air were calculated to range from 0.0006 micrograms per liter (ug/L) to 0.002 ug/L. Air concentrations were calculated using the following equation:

$$\frac{\text{Analytical Result (ug/filter)}}{\text{Pumping rate (L/min)} \times \text{pumping time (min/filter)}} = \underset{\text{(ug/L)}}{\text{Air Concentration}}$$

The calculation for total chromium in AS-2 is as follows:

$$\frac{0.36 \text{ ug/filter}}{1.5 \text{ L/min} \times 200 \text{ min/filter}} = 0.0012 \text{ ug/L}$$

The complete air sampling analytical results are shown in Table 8.

3.2.7.2 Volatile Organic Headspace Analysis

During volatile organic analysis of the soil samples, high concentrations of carbon disulfide created difficulty in determining whether other volatile organics were present at lower concentrations. To further evaluate the presence of other volatile organics, volatile organic static headspace analyses were performed on the samples. The headspace analysis is a routine part of volatile organic analyses at the laboratory. Each sample requiring volatile organic analysis is analyzed by a static headspace analyzer attached to a gas chromatograph fitted with a flame ionization detector. Samples may be analyzed without dilution by this technique even in the presence of very high concentrations of volatile organics.

According to the laboratory report, meaningful results were obtained only for the compounds: benzene, toluene, ethylbenzene, xylenes, tetrachloroethene and trichloroethene. The results for other compounds were not conclusive or meaningful based on the information obtained from the chromatograph. Benzene was detected in three samples at concentrations of 0.9 ppm to 7.9 ppm. Toluene was detected in two samples at concentrations of 0.8 ppm and 0.9 ppm. Ethyl benzene was detected in four samples at concentrations of 0.8 ppm to 14.3 ppm. Xylenes were detected in five samples at concentrations of 0.5 ppm to 8.4 ppm. Tetrachloroethene was found in eight samples at concentrations of 0.8 ppm to 170 ppm. Trichloroethene was found in one sample at 4.2 ppm. A summary of the complete headspace analysis results is included in Table 9.

3.2.7.3 Quality Assurance Sample Results

The field duplicate soil samples were labeled as sequential samples and treated by the laboratory as blind duplicates. The analytical results for all duplicate samples are shown on the appropriate attached tables beside their associated environmental samples. The duplicate samples are identified by their sample number and duplicate number (for example, 078 (DUP-3)).

A summary of the analytical results for all equipment rinsate blanks, field blanks, and trip blanks is provided in Table 10. Results for other quality control samples (matrix spike, matrix spike duplicates, etc.) are included in the full data packages (Volumes 2-19).

3.2.8 Data Validation

Validation of the analytical data obtained during the RAP implementation was performed by Trillium, Inc. (Trillium) of Stewartsville, New Jersey. Individual Data Validation reports were submitted by Trillium for each Sample Delivery Group (SDG) assigned by Envirotech and for each analyzed parameter within each SDG. The Trillium reports are included in Volumes 20 through 22 of this RAR. Trillium's evaluation was performed in conformance with "Region III Modifications to National Functional Guidelines for Organic Data Review", (September 1994), as well as "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", EPA 540/R-94/012 (February 1994), and professional judgement as necessary and appropriate. Trillium specified that the end user of the data should be cautioned that no analyte concentration is guaranteed to be accurate even if all associated quality control is acceptable. Strict quality control conformance serves only to increase confidence in reported results; any analytical result will always contain some error. According to Trillium, the evaluation reports should be considered part of the data package for all future distributions of the data. All results discussed in this RAR and presented on the attached tables and figures have been revised to include Trillium's data revisions.

The following is a list of the analyzed parameters along with a brief summary of the common problems that were encountered and reported for that parameter. This summary was based upon Trillium's data validation reports.

<u>Volatile Organics</u> - Based on the findings of the data evaluation, all sample results were determined to be valid as reported with the following exceptions. A number of tentatively identified compounds (TICs) were rejected as system

artifacts, qualifier codes were either added or deleted, and a change in carbon disulfide concentration was made at a single sample location (TP-23-132) based on validator calculations. In addition, the retention time for the m, p-xylenes peak was stated as incorrect during the initial calibration (IC). However, since no xylenes were detected in any of the samples in any data package, no corrective action in the IC standards is necessary. Documentation problems with chain of custody (COC) records noted by the validator, such as illegible signatures, do not directly affect the validity of the data.

Semivolatile Organics - Based on the findings of the data evaluation, all sample results were determined to be valid as reported with the following exceptions. Qualifier codes were either added or deleted; TICs were rejected as laboratory contaminants or qualified with a 'B' based on method blank contamination; the identification of a TIC was corrected; results were qualified with a 'B' based on method and field blank contamination of bis(2-ethylhexyl) phthalate; various compounds were rejected as analytical artifacts; and the results for pentachlorophenol were rejected in one sample based on the unacceptable agreement between paired results. The validator recommends caution be used in the use of the result reported for bis(2-ethylhexyl) phthalate in one sample (TP-26-110) as the compound may be a laboratory contaminant and not a true sample component. Documentation problems noted by the validator including COC records and data presentation do not directly affect the validity of the data.

Pesticides/PCBs - Trillium recommends that these results be used with extreme caution based on the very poor agreement between columns for positively reported compounds. Also, the erratic and divergent quality control results in conjunction with low concentrations of reported compounds strongly suggests that the detected pesticides are more than likely false positives. The following qualifications of sample results is based on the findings of the validation effort. Qualifier codes were either added or deleted, various compounds were rejected based on the results exceeding laboratory established calibration range for the instrument, and unacceptable surrogate and matrix spike recoveries. Documentation problems noted by the validator including COC records and data presentation do not directly affect the validity of the data.

Metals and Cyanide - Based on the findings of the data evaluation, all sample results were determined to be valid as reported with the following exceptions.

Qualifier codes were either added or deleted, and a number of results were qualified with a 'B' based on laboratory, calibration, field, rinsate, and preparation blank contamination. Documentation problems noted by the validator including COC records do not directly affect the validity of the data.

Total and Soluble Arsenic - Based on the findings of the data evaluation, all sample results were determined to be valid as reported with the following exceptions. Qualifier codes were either added or deleted, and a sample number was corrected on the sample Form I.

Wet Chemistry - Based on the findings of the data evaluation, all sample results were determined to be valid as reported with the following exceptions. Qualifier codes were either added or deleted, and data was rejected based on unacceptable agreement and producability between paired results. Documentation problems with COC records noted by the validator do not directly affect the validity of the data. However, because the results were reported as a "reduced deliverables" format, which includes summary forms only and not the supporting raw data, the validator must assume that the summary results presented by the laboratory are accurate and reliable in order to perform an evaluation of the results. The missing raw data does present a problem with respect to the defensibility of the data.

TCLP Volatile Organics - Based on the findings of the data evaluation, all sample results were determined to be valid as reported except for the addition or deletion of qualifier codes. Documentation problems with COC records noted by the validator do not directly affect the validity of the data. However, because the results were reported in a "reduced deliverables" format, which includes summary forms only and not the supporting raw data, the validator must assume that the summary results presented by the laboratory are accurate and reliable in order to perform an evaluation of the results. In addition, documentation of TCLP extractions of the soil samples was not included in the data package. The missing raw data does present a problem to the defensibility of the data.

TCLP Semivolatile Organics - Based on the findings of the data evaluation, all sample results were determined to be valid as reported except for the addition or deletion of qualifier codes. Documentation problems with COC records noted by the validator do not directly affect the validity of the data. However, because the results were reported as a "reduced deliverables" format, which includes summary forms only and not the supporting raw data, the validator must assume that the summary results presented by the laboratory are accurate and reliable in order to perform an evaluation of the results. The missing raw data does present a problem with respect to the defensibility of the data.

TCLP Pesticides/Herbicides - Based on the findings of the data evaluation, all sample results were determined to be valid as reported except for the addition or deletion of qualifier codes. Documentation problems with COC records noted by the validator do not directly affect the validity of the data. However, because the results were reported as a "reduced deliverables" format, which includes summary forms only and not the supporting raw data, the validator must assume that the summary results presented by the laboratory are accurate and reliable in order to perform an evaluation of the results. The missing raw data does present a problem with respect to the defensibility of the data.

TCLP Metals - Based on the findings of the data evaluation, all sample results were determined to be valid as reported except for the addition of qualifier codes based on blank contamination of the compound. Documentation problems with COC records noted by the validator do not directly affect the validity of the data. However, because the results were reported as a "reduced deliverables" format, which includes summary forms only and not the supporting raw data, the validator must assume that the summary results presented by the laboratory are accurate and reliable in order to perform an evaluation of the results. The missing raw data does present a problem with respect to the defensibility of the data.

3.3 Site Security

Site security measures were implemented in order to preclude access to contaminated areas by persons not performing or overseeing the response actions required by the Order. USEPA was notified of the proposed implementation of site security measures in Langan's letters of 18 August and 29 November 1995. Approximately 1,700 linear feet of six-foot high chain link fence topped with three strands of barbed wire were installed around the drainage ditch area, measuring about 330 feet by 120 feet, and along the Conrail right-of-way from the I-495 embankment to the previously existing process plant area fence. Access to the site from the railroad embankment is thus restricted, as is access to the most contaminated area of the site, the drainage ditch. Warning signs reading "Danger-Environmental Hazard - Unauthorized Personnel Keep

Out" were posted along the fence at 50 foot intervals. Locking gates sufficient to permit access to the site by personnel and/or equipment were constructed in each section of fence and secured with padlocks. The location of the site security fence is shown on Figure 11. During installation of the fence along the Conrail right-of-way, the water main was hit at three fence post locations and the pipe's plastic coating was slightly damaged. The water main was subsequently exposed at those locations, and the plastic pipe coating was repaired.

3.4 Fire Protection

Fire protection appropriate to the conditions at the site were provided during all RAP implementation activities. Specific measures included the availability of water fog equipment, chemical fire extinguishers and ventilation fans.

3.5 Stormwater and Other Water Controls

Water controls were constructed to regulate the impact of stormwater and tidal water flows on the lagoon and drainage ditch areas. The controls included repairs to the breached section of the lagoon's northwest bank and isolation of the drainage ditch sediments using a temporary cap. The water controls implemented are intended as temporary measures. Permanent controls will be incorporated into the final remedy for the site. All clean fill brought to the site was purchased from Parkway Gravel, Inc. of New Castle, Delaware. A clean fill certification and fill receipts are provided in Appendix D. As-built construction details of the water controls are shown on Figure 11.

3.5.1 Lagoon

To minimize tidal fluctuations in the lagoon and drainage ditch and migration of site contaminants, a dike was constructed across the breached section of the lagoon's northwest bank. On 21 and 22 December 1995, Code, under Langan's supervision, constructed the dike across the breach to an elevation of four feet MSL. Construction of the dike to an elevation of four feet MSL permits the lagoon to continue to drain via the I-495 drainage ditch, but does not permit tidal fluctuations to affect water levels in the lagoon. Construction commenced at low tide using a tire-mounted backhoe to excavate approximately one to two feet of sand and gravel from the bottom and sides of the breach. The loose sand and gravel was excavated in order to provide a sound foundation for the dike. A temporary dike was constructed on the lagoon side of the breach, and the excavated area was dewatered. Clean sandy fill was placed within the excavation in one foot thick lifts and compacted to a dense state using a vibrating plate compactor. The compacted sandy fill was brought to within one foot of the dike's finished grade, and was covered with a layer of 40-mil thick high density polyethylene (HDPE) liner. The HDPE liner was covered and secured using cobble-sized stone rip-rap. As of the completion of this report, the dike appeared to be in good condition and performing its intended role.

3.5.2 Drainage Ditch

As proposed in the RAP, stormwater controls for the on-site drainage ditch were to consist of a system of berms and ditches to divert surface flow away from the ditch and into the lagoon. With USEPA's approval, obtained though verbal consultation on 27 December 1995 confirmed in Langan's letter to USEPA of 10 January 1996, the proposed stormwater controls were modified to consist of clearing, regrading and temporarily capping the drainage ditch.

On 28 and 29 December 1995, Code, under Langan supervision, cleared, regraded and covered the drainage ditch. Vegetation and trees within the fenced drainage ditch area were cleared and chipped, and debris was consolidated and stockpiled. Water within the drainage ditch was pumped into the lagoon, and the ditch area was rough-graded using a Cat D-5 bulldozer. The Liner Company, of Morganville, New Jersey, was subcontracted by Code to install a 40-mil thick HDPE liner over the ditch. The liner covers the ditch from the north edge of the fenced area to the area excavated and backfilled during the USEPA removal action at the south end of the ditch.

To cover the ditch, two 300-foot long by 15-foot wide sections of liner were thermally welded forming a 300-foot long by 30-foot wide liner section. Test welds performed on scrap sections of liner were visually inspected to ensure the proper operation of the equipment. After the liner sections were welded together, the liner was pulled into place over the ditch. Approximately 1,200 cubic yards of clean sandy fill was imported to the site and used to cover the liner with a thickness of three to four feet. The fill was then compacted using a rubber-tired front end loader.

3.6 Minimization of Fugitive Emissions

During implementation of the RAP, air quality in the vicinity of site operations was monitored for particulates, site contaminants, volatile organic vapors and odors. Dust suppression equipment consisting of water sprayers was available during site operations but was not required. In order to minimize volatile organic emissions and odors, excavation activities were performed in as unintrusive a manner as possible, and excavations were sampled and backfilled as quickly as possible. It should be noted that although strong pungent odors were noted during the excavation of several test pits, breathing zone concentrations of volatile organic vapors rarely reached detectable levels.

3.7 Isolation of Water Main, Utilities and Services

As discussed in Section 1.1 of this report, a remediation work plan will be submitted to USEPA for approval in accordance with the project schedule. Soils adjacent to the water main will be included within the scope of the work plan. Based on the available sampling data, contaminant concentrations immediately surrounding the water main are minimal and further measures to isolate the main will not be required.

3.8 Treatability Study

A treatability study was initiated in April 1996 for the purpose of determining the effectiveness, efficiency and practicability of treating the contaminated site soils with various oxidizing agents. A proposal to collect soil samples for use in the treatability study was submitted to USEPA in Langan's letter of 25 March 1996. Carbon disulfide contamination is the focus of the study. As of the completion date of this report, the treatability study was in progress. Periodic treatability study progress reports are being submitted to USEPA during the treatability study. A final Treatability Study Report presenting the study results and recommendations for treating the site soils will be submitted under separate cover in accordance with the project schedule.

3.9 Identification of Soil Cleanup Levels

Witco has completed a risk assessment for the Halby site and has identified soil cleanup levels which Witco believes are sufficient to protect human health and the environment. The risk assessment was submitted to USEPA for approval on 25 March 1996. Witco was subsequently informed that USEPA was proceeding to update the Revised RI and Risk Assessment for OU-2 and would not incorporate the findings of

Witco's risk assessment. USEPA's updated Revised RI and Risk Assessment for OU-2 was issued in May 1996. The updated revised RI for OU-2 incorporates data obtained during USEPA's 1995 removal action and Witco's 1995/1996 RAP implementation. Contaminants-of-concern are identified in the updated Revised RI, but soil cleanup levels are not presented. Because mutually agreed upon soil cleanup levels are not yet available, this RAR presents contaminant data obtained during the RAP implementation without evaluation with respect to cleanup levels. As of the completion data of this RAR, discussions on soil cleanup levels were ongoing.

3.10 Stabilization of Contaminated Soils, Sediments and Sludges

As discussed in Section 1.1 of this report, a remediation work plan will be submitted to USEPA for approval in accordance with the project schedule. The work plan will incorporate the findings of the treatability study and the waste removal/remedial option research to provide the most effective, efficient and practicable approach to treating the contaminated site soils, sediments and sludges.

3.11 Waste Classification and Disposal

As stipulated in the Order, Witco is required to provide for proper disposal of contaminated materials which cannot or will not be remediated. As of the completion date of this report, remedial actions had not been implemented at the site, and no contaminated site materials had been treated or disposed of. For soils that may require disposal during future remedial actions, Witco has classified the site wastes in accordance with Federal and Delaware regulations governing hazardous waste. The following classifications are based on analytical results obtained during the USEPA removal action of 1995 and Witco's RAP implementation, and on available information concerning production operations at the site. A Preliminary Waste Classification Report was submitted to USEPA on 30 April 1996 in accordance with the project schedule.

3.11.1 Analytical Data

During the USEPA removal action in 1995, approximately 25 soil samples were collected from the drainage ditch area and from soil excavated in and around the former sump location. Soils excavated from the sump area were stockpiled on-site. The samples were analyzed for various waste classification parameters including the RCRA characteristics of ignitability, corrosivity, reactivity and toxicity, although not all samples were analyzed for each parameter. The analytical results for the USEPA samples are summarized in Tables EPA-1, EPA-2 and EPA-3.

The RAP implementation in 1995/1996 included the collection and analysis of approximately 130 soil samples to further delineate site contaminants. The samples were collected primarily from the former drainage ditch area and from the process plant area. In order to evaluate disposal options for the contaminated site soils, the samples from each test pit which appeared to be most contaminated were submitted for waste classification analyses. The waste classification parameters included:

- Toxicity characteristic leaching procedure (TCLP) volatile organic compounds (VOC);
- TCLP semi volatile organic compounds (SVOC);
- TCLP pesticides;
- TCLP herbicides;
- TCLP metals;
- Ignitability;
- Corrosivity;
- Reactive sulfide; and,
- Reactive cyanide.

The results of the waste classification analyses are summarized in the tables included in this report for the first water main investigation (Table 1), the second water main investigation (Table 2), the drainage ditch delineation (Table 5), and the sump area delineation (Table 6).

3.11.2 Federal Regulations

According to the regulations contained in 40 CFR Part 261-Identification and Listing of Hazardous Waste, some of the soils at the site could be considered to contain hazardous constituents or wastes and would not be excluded from regulation as a hazardous waste. Determination of whether the soil in fact contains a hazardous waste was pursued on two tracks; first, does the soil exhibit any of the characteristics specified in 40 CFR Part 261 Subpart C - Characteristics of Hazardous Waste; and second, would the contaminating constituents be listed as a hazardous waste under 40 CFR Part 261 Subpart D - Lists of Hazardous Waste.

3.11.2.1 Part 261 Subpart C - Characteristics of Hazardous Waste

Part 261 Subpart C identifies four characteristics of hazardous waste including ignitability, corrosivity, reactivity and toxicity. A solid waste which is not excluded from regulation as a hazardous waste is considered a hazardous waste if it exhibits any of the four above-mentioned characteristics.

Analysis for the characteristic of ignitability showed that none of the samples collected during the RAP implementation exhibited a flashpoint less than 160°F. Samples collected from excavated sump area soils during the USEPA removal action did not exhibit a flashpoint of less than 212°F. According to USEPA data, two samples collected from the drainage ditch may have exhibited the characteristic of ignitability. Sample HAS-3A (1.5 feet to 2.5 feet below grade) and HAS-5B (0.5 feet to 1.0 feet) were reported to be ignitable at 71.6°F. According to federal hazardous waste regulations, a liquid is considered ignitable if it exhibits a flashpoint of less than 140°F, and a solid is considered ignitable if it burns vigorously and persistently. It is unknown whether the samples were considered liquids (in which case they would be ignitable), or if they were solids (in which case no information is available to determine if they burned vigorously and persistently). None of the other drainage ditch area samples were reported to be ignitable. Witco recognizes the fact that soil flashing was observed at several locations during excavation at the site and that appropriate health and safety precautions will be required during future handling of the soil.

Analysis for the characteristic of corrosivity showed that none of the samples exhibited a pH of less than 2 standard units or greater than 12.5 standard units. Based on the available analytical data, the contaminated soil does not exhibit the characteristic of corrosivity.

Analysis for the characteristic of reactivity included analyses for reactive cyanide and reactive sulfide. According to the USEPA document "SW-846, Test Methods For Evaluating Solid Waste" (USEPA, 1986), the USEPA action levels for total releasable cyanide and total releasable sulfide are 250 ppm and 500 ppm, respectively. The analytical results show that reactive cyanide was not detected in any of the Witco samples. Reactive cyanide was detected below the action level in four USEPA samples at concentrations of 0.038 ppm to 1.23 ppm. Reactive sulfide was detected above the action level (500 ppm) in two of the Witco samples: sample TP-31-101 (3.0 feet to 3.5 feet below grade) at 556 ppm and sample TP-35-139 (5.0 feet to 5.5 feet) at 609 ppm. Reactive sulfide was detected above the action level in four of the USEPA samples of excavated sump soils (samples HC-A, HC-B, HC-C and HC-31) at concentrations of 2,820 ppm to 14,300 ppm. Reactive sulfide detected in four of the USEPA drainage ditch samples exceeded the action level: samples HAS-2B (3.0 feet) at 3,440 ppm; HAS-5B (0.5 feet to 1.0 feet) at 42,000 ppm; HAS-6A (1.0 feet) at 2,500 ppm; and HAS-8B (1.0 feet to 1.5 feet) at 950 ppm. Based on the available analytical data, four samples of the excavated sump area soils and six samples of the drainage ditch soils exhibited the characteristic of reactivity.

Analysis for the characteristic of toxicity included analyses for the TCLP VOCs, TCLP SVOCs, TCLP pesticides, TCLP herbicides and TCLP metals identified in Part 261 Subpart C. The analytical results show that five of the Witco samples exceeded the RCRA TCLP Threshold Levels (TCLP Limit) for various metals. At test pit locations TP-11, TP-13 and TP-24, arsenic was detected in sample numbers 116 (3.5 feet to 4.0 feet below grade), 118 (5.5 feet to 6.0 feet) and 072 (2.6 feet to 3.1 feet) at concentrations of 36.1 ppm, 5.6 ppm and 5.7 ppm, respectively. The TCLP Limit for arsenic is 5.0 ppm. At test pit location TP-23, barium was detected in sample number 132 (7.5 feet to 8.0 feet) at 126 ppm. The TCLP Limit for barium is 100 ppm. At test pit location TP-29, lead was detected in sample number 070 (3.0 feet to 3.5 feet) at 6.6 ppm. The TCLP Limit for lead is 5.0 ppm. No other metals, and no volatile, semivolatile, pesticide or herbicide compounds, were detected above their respective TCLP Limits in the Witco samples. It should be noted that carbon disulfide is not listed as a toxicity characteristic contaminant and was not analyzed by TCLP. None of the EPA removal action samples showed TCLP contaminant concentrations above their respective TCLP Limits. Based on the available analytical results, contaminated soil managed for disposal from five locations (TP-11, TP-13, TP-23, TP-24 and TP-29) would be classified with the characteristic of toxicity for either arsenic, barium or lead.

3.11.2.2 Part 261 Subpart D - Lists of Hazardous Waste

Part 261 Subpart D lists types of hazardous waste originating from specific sources, non-specific sources, and discarded chemical products, off-specification products, container residues or spills. Subpart D also assigns USEPA Hazardous Waste Numbers to a waste based upon the source of that waste. Of the contaminants present at the site, sufficient information concerning potential sources and process operations was only available to determine if carbon disulfide was a listed waste. Based on the available information, carbon disulfide contaminated soils managed for disposal would be a listed waste with a USEPA Hazardous Waste Number of P022 (CAS 75-15-0).

3.11.2.3 Part 262 - Standards Applicable to Generators of Hazardous Waste

Several soil samples exhibited the characteristics of hazardous waste and the carbon disulfide contamination would be listed as a hazardous waste. Witco has therefore taken action to comply with the requirements of 40 CFR Part 262. Witco has applied for a USEPA Generator Identification Number for the Halby site as described in Section 3.14 of this report.

3.11.3 Delaware Regulations

Classification of the on-site wastes under the Delaware regulations governing hazardous waste would not differ from the waste classification under the federal regulations. The applicable DNREC hazardous waste numbers for the wastes are identical to their corresponding USEPA hazardous waste numbers.

3.11.4 Waste Classifications

Based on a review of the applicable regulations and available site information, the site-related carbon disulfide contaminated soil would be listed as

Hazardous Waste Number P022 if it is managed for disposal. Based on the available analytical data, wastes at various locations within the drainage ditch area, if managed for disposal, would receive Hazardous Waste Numbers: D003 for sulfide reactivity; D004 for arsenic; D005 for barium; or D008 for lead. Wastes at two locations within the drainage ditch might receive Hazardous Waste Number D001 for ignitiability if managed for disposal.

In addition, some of the sump area soils excavated and stockpiled on-site by USEPA in May and June 1995 exhibited characteristics of hazardous waste. However, it should be noted that the sump area soil stockpiles have since been transferred to the drainage ditch area and consolidated. The USEPA sample results obtained in 1995 for the sump area soils may no longer be representative of the actual soil characteristics. The stockpiled soil will need to be reanalyzed in order to confirm its waste classification characteristics.

3.12 Post Excavation/Post Treatment Sampling

As discussed in Section 1.1 of this report, a remediation work plan will be submitted to USEPA for approval in accordance with the project schedule. The work plan will provide for post excavation or post treatment sampling to ensure that soil contaminant levels are below the USEPA approved cleanup levels. As of the completion date of this report, soil cleanup levels had not yet been approved (see Section 3.9).

3.13 Site Specific Health and Safety Plan

A site specific health and safety plan (HASP) was prepared as part of the RAP and submitted to USEPA on 8 August 1995. Revised versions of the HASP were submitted to USEPA on 1 September 1995 and 20 November 1995. Based on the then - available site information and scope of work, the HASP established the health and safety zones (exclusion zones, decontamination zones, and support zones) and health and safety procedures for planned activities. Specifically, the HASP: defined the responsibilities of project team members with respect to health and safety; identified potential hazards associated with the proposed field activities; specified air monitoring procedures, personal protective equipment and action levels; and identified site controls, decontamination procedures, general work practices and emergency response measures. The HASP was adhered to during the RAP implementation.

3.14 Hazardous Waste Generator Identification Number

An application for a USEPA Hazardous Waste Generator Identification Number was completed and submitted to USEPA on 4 April 1996. A copy of the application is provided in Appendix E of this report. According to the DNREC Hazardous Waste Management Branch, the Halby site has been assigned USEPA Hazardous Waste Generator Identification Number DER-000000430.

3.15 Exposure of Aquatic Species

In order to develop a plan to minimize the exposure of aquatic species to hazardous site contaminants, Witco has conducted research and requested meetings with regulatory agencies to discuss wetland delineation and mitigation issues at the site. Research completed to date has included investigation of wetlands jurisdiction and delineation issues. Design and implementation concerns associated with on-site and off-site wetland mitigation measures have also been examined.

On 22 February 1996, a letter was submitted to USEPA requesting a joint inter-agency meeting between the following agencies: the United States Army Corps of Engineers, United States Fish and Wildlife Service, National Marine Fisheries Service, Delaware Division of Fish and Wildlife, DNREC and USEPA. As of the completion date of this report, USEPA had not responded to Witco's joint meeting request. The results of Witco's research and of the joint meeting, when it is convened, will be used to prepare a plan to minimize the exposure of aquatic species to hazardous site contaminants. No further work on the wetlands (delineation, survey, etc.) will be conducted until after the joint inter-agency meeting.

At present, the lagoon area is segregated from offsite marsh areas and from the ditch. To that end, the lagoon and offsite aquatic species have been temporarily protected from additional exposure until such time as a final remedy is chosen for the site.

3.16 Project Schedule

All work performed by Witco as part of the RAP implementation was completed on schedule, which was approved by USEPA. A proposed project schedule for implementation of the RAP was prepared and submitted to USEPA for approval on 8 August 1995 as part of the RAP. Proposed schedule changes were submitted to USEPA in Langan's letter of 13 March 1996. Revisions to the schedule were conditionally accepted by USEPA on 19 March 1996. USEPA's comments were incorporated into the revised schedule included in this report as Appendix F. Additional proposed schedule revisions were submitted to USEPA for approval on 14 June 1996. As of the completion date of this report, USEPA had not yet approved the revisions.

3.17 Backfilling of Excavated Areas

All test pits excavated during implementation of the RAP were backfilled to the original surface grade using the previously excavated soils as proposed in the SAP. Backfilling of the lagoon dike and the drainage ditch to control storm water and tidal water was performed using clean fill from an off-site source. As discussed in Section 1.1, a remediation work plan will be submitted to USEPA for approval in accordance with the project schedule. The work plan will provide for backfilling of areas excavated during remediation of the site.

3.18 Post-Removal Maintenance

As discussed in Section 1.1 of this report, a remediation work plan will be submitted to USEPA for approval in accordance with the project schedule. The work plan will provide for post-removal maintenance of the selected remedy to assure that the remedy remains protective of human health and the environment.

4.0 SUMMARY AND CONCLUSIONS

Witco has prepared and implemented a Response Action Plan at the Halby site to achieve the objectives and requirements of the Administrative Order for Removal Response Action. The RAP presented a schedule and strategy for completing the work items specified in the Order and included a soil, groundwater and air sampling investigation to supplement exiting site-contaminant data. All work performed as part of the RAP implementation was completed in accordance with the USEPA-approved project schedule. USEPA's approval was secured for all major modifications to the RAP. Notification of field-modifications to the RAP were submitted to USEPA as appropriate.

As of the completion date of this report, no contaminated soils had been treated or removed from the site. A treatability study was in progress and research into potentially applicable waste removal and remedial options was being performed. The results of the treatability study and remedial/removal option research will be used to select the most appropriate remedy for the site contamination. A work plan describing the ultimate remedy will be submitted to USEPA in accordance with the project schedule.

Because the site remedy has not yet been selected, several work items specified in the order have not yet been performed. The following work items will be performed, as required, in accordance with the project schedule: stabilization of contaminated soils, sediments and sludges; disposal of materials which cannot be remediated; post-excavation and/or treatment sampling; minimize exposure of aquatic species; backfilling of excavated areas; and post-removal maintenance.

Observations, information and analytical data obtained during implementation of the RAP are summarized below. The following summaries are intended to provide a general description of site conditions and serve as a guide when considering potential remedial options for the site. Since no USEPA-approved soil cleanup levels are available, no specific conclusions could be drawn concerning the extent or volume of contaminated soil to be remediated.

4.1 Water Main

A total of 12 test pits were excavated along the water main, with 26 soil samples and one groundwater sample being collected and analyzed. The 16-inch diameter cast iron water main was exposed, examined and tested to evaluate its physical condition. Soil surrounding the water main was tested to identify any potentially corrosive influences on the piping.

The soils encountered along the water main generally consisted of five to six feet of fill materials overlying an apparently natural silt and clay formation. The fill was composed of sand, gravel, cinders and slag and was possibly placed on-site during construction of the rail line or water main. Based on the soil sample analytical results, the horizontal distribution of site contaminants appears to be such that the greatest concentrations along the water main are located adjacent to the drainage ditch. Vertically, site contaminants were typically identified at relatively low concentrations in samples collected above or at the base of the water main. Samples collected at or near the top of the silt and clay formation generally showed the highest concentrations of site contaminants, and often showed concentrations several times higher than the shallow samples.

According to RAM Services, the results of the water main inspection and corrosion testing indicate that the piping at the inspection points appears to be in excellent condition. The inspection points were located adjacent to the drainage ditch, the area showing the highest contaminant concentrations. Furthermore, the water main is located in what RAM Services considers to be a moderately corrosive environment. Considering the age of the water main (approximately 30 years), the condition of the piping adjacent to the ditch, and the moderately corrosive environment, it appears that site contaminants have not affected the integrity of the water main.

4.2 Drainage Ditch

A total of 16 test pits were excavated within the drainage ditch area, and 30 soil samples were collected and analyzed. The soils encountered typically consisted of up to seven feet of fill materials overlying a two foot to six foot thick layer of silt and/or clay. A sand, silt and clay formation was encountered beneath the silt/clay layer. The fill materials generally consisted of sand, gravel, cinders, slag, construction debris and automobile tires. The silt/clay layer was interpreted as the Recent Sediments formation, and the underlying sandy soils were interpreted as Columbia Formation soils.

Based on the soil sample analytical results, the horizontal distribution of site contaminants within the drainage ditch area roughly conforms to the limits of the former on-site lagoon (see Figures 3 through 9). Contaminant concentrations typically increase with proximity to the drainage ditch, with the highest concentrations occurring within the ditch itself. Vertically, samples collected from the upper few feet of the silt/clay layer typically exhibited the highest concentrations of site contaminants. Deeper samples, collected from the sandy soils beneath the silt/clay layer typically showed lower contaminant concentrations, although several samples showed relatively high concentrations.

4.3 Sump Area

A total of four tests pits were excavated around the former sump area, and eight soil samples were collected and analyzed. The soils encountered consisted of two to four feet of fill materials overlying an apparently natural silt and/or clay layer. The fill materials consisted of sand, silt, gravel, glass and small amounts of construction debris.

Based on the soil sample analytical results, site contaminants were generally detected at relatively low concentrations (in comparison to the drainage ditch area samples). Samples collected near the top of the silt/clay layer generally showed contaminant concentrations similar to or slightly higher than the deeper samples.

4.4 Process Plant Area

A total of 10 soil borings were completed in the process plant area, and 58 soil samples were collected and analyzed. The soils encountered consisted of up to seven feet of sand, silt, gravel and clay overlying black sand and silt. All of the soils appeared to be fill materials, and the black soil appeared to possibly be ash or powdered coal.

Based on the soil sample analytical results, the highest arsenic concentrations were typically encountered in the upper two feet of soil. At two locations, relatively high arsenic concentrations were encountered at depths of seven to ten feet. Although low levels of arsenic were detected in all samples, overall the levels detected are somewhat sporadic.

4.5. Waste Classification

Wastes at the site have been classified according to Federal and Delaware regulations governing hazardous waste. Based on available information concerning the sources of the site wastes, soils contaminated with carbon disulfide that would be managed for disposal would be a listed waste and would receive a hazardous waste number of P022. Information sufficient to determine whether other wastes would also be listed wastes was not available. Based on the available analytical data, wastes at various locations within the drainage ditch that would be managed for disposal would receive hazardous waste numbers: D003 for sulfide reactivity; D004 for arsenic; D005 for barium; or D008 for lead. Wastes at two locations within the drainage ditch might receive Hazardous Waste Number D001 for ignitability if managed for disposal. Soils excavated from the sump area by USEPA and stockpiled on-site previously exhibited characteristics of hazardous waste. Because the stockpiled soil has since been transferred to the drainage ditch area and consolidated, it will need to be reanalyzed in order to confirm its waste classification characteristics.

4.6 Stormwater and Other Water Controls

Temporary water controls were constructed to regulate the impact of stormwater and tidal water flows on the lagoon and drainage ditch areas. The controls included the construction of a dike across the breached section of the lagoon bank to obstruct tidal flows into and out of the lagoon, and the construction of a cap over the drainage ditch to isolate the contaminated sediments.

As of the completion date of this RAR, the dike and cap appear to be in good condition and performing their intended roles. Permanent water controls will be incorporated into the final remedy for the site.

4.7 Additional Work Items

Additional work items required by the Order and implemented during the RAP implementation are summarized below.

4.7.1 Site Security

Site security measures were implemented to restrict access to contaminated areas of the site by persons not involved in the response activities. A six-foot high chain link fence topped with barbed wire was constructed along the Conrail right-of-way from the I-495 embankment to the previously existing process plant area fence. The drainage ditch area was enclosed with a similar fence. Warning signs were placed along the fence at 50 foot intervals to warn passers-by of site hazards.

4.7.2 Fire Protection

Fire protection measures consisting of water fog equipment, fire extinguishers and ventilation fans were available for use during work at the site.

4.7.3 Minimization of Fugitive Emissions

Air quality was monitored during site activities for airborne site-related contaminants. In order to minimize fugitive emissions, dust suppression equipment was available for use, and excavation activities were performed as quickly and unintrusively as possible. Monitoring results showed that breathing zone concentrations of dust, volatile organic vapors and other site contaminants rarely reached detectable levels. Strong pungent odors were, however, noted during the excavation of several test pits.

4.7.4 Isolation of Water Main, Utilities and Services

Based on the soil contaminant data obtained during the RAP implementation, contaminant concentrations surrounding the water main are minimal. Further measures to isolate the water main for purposes of worker safety will not be required.

4.7.5 Treatability Study

A treatability study was initiated in April 1996 to examine the practicability of treating carbon disulfide contamination using various oxidizing agents. A final Treatability Study Report documenting the study results will be submitted to USEPA in accordance with the project schedule.

4.7.6 Identification of Soil Cleanup Levels

A risk assessment identifying soil cleanup levels for the site was performed by Witco and submitted to USEPA on 25 March 1996. Witco was subsequently informed that the risk assessment findings would not be incorporated into an updated Revised RI for OU-2 being prepared by USEPA. The updated Revised RI for OU-2 was issued in May 1996. As of the completion date of this RAR, discussions on soil cleanup levels for the site were ongoing.

4.7.7 Site Specific Health and Safety Plan

A HASP was prepared as part of the RAP and submitted to USEPA for approval. The HASP established the health and safety zones and health and safety procedures for planned site activities. The HASP was adhered to during the RAP implementation.

4.7.8 Hazardous Waste Generator Identification Number

An application for a USEPA Generator Identification Number was completed for the Halby site and submitted to USEPA. The Halby site has been assigned USEPA Hazardous Waste Generator Identification Number DER-000000430.

4.7.9 Project Schedule

A project schedule for implementation of the RAP was prepared and submitted to USEPA. The project schedule, with USEPA-approved revisions, was adhered to during implementation of the RAP and is presented in Appendix F of this report. As of the completion date of this report, additional proposed revisions to the project schedule were awaiting USEPA approval.